SOCIAL SCIENCES

Industrial Hygiene Section

INDUSTRIAL MEDICINE

The Journal of Occupational Diseases and Traumatic Surgery

October, 1941

Traumatic Intracranial Hemorrhage
— With Particular Reference to Surgical Management —

Cardiovascular Disabilities
— of Railway Employees —

Inguinal Hernia
— Newer Methods of Repair —

Medicolegal Aspects
— Traumatic Injuries —

Modern Burn Treatment
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Tuberculosis in Industry
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Radium Hazards
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SIGNIFICANCES of major importance are plentiful in this issue. Not the least among them is the fact that the pictures and text descriptive of Commonwealth Edison's Medical Offices (page 423) are from a *news release*. Medical departments and medical services are *news*. Industrial medicine has come a long way since the publication, 12 years ago, of the almost prophetic words: "It is a phenomenon of public goodwill that the highest point to which it can be developed by *products* is far below the higher point to which it will climb when the public becomes aware of *the employer's real efforts to improve the conditions from which the products come*." This is the second such news release within the year. There will be many more, until the matter becomes so much a part of the routine of big business that it will cease to be news. Then it will start all over again, when it begins to be the necessary adjunct of little business. A decade ago the former was only a question of time. Now the latter in turn is also only a question of time . . . Another significance is inherent in the "Working Conditions" survey on page 432. DR. HAYHURST says of it that, although the basis of derived data is not overly scientific, "the report is a pretty good job for a labor group which is trying to do something in the industrial health field." . . . A THIRD is contained in the editorial (page 445). It needs no elaboration here. . . . A FOURTH, fifth, sixth—as many as you have time for—are also present . . .

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Official Publication

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THE object of this Association shall be to foster the study and discussion of the problems peculiar to the practice of industrial medicine and surgery; to develop methods adapted to the conservation of health among workers in the industries; to promote a more general understanding of the purposes and results of the medical care of employees, and to unite into one organization members of the medical profession specializing in industrial medicine and surgery for ther mutual advancement in the practice of their profession.

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The Twenty-Seventh (1942) Annual Meeting of the American Association of Industrial Physicians and Surgeons and the Third (1942) Annual Meeting of the American Industrial Hygiene Association will be held at Cincinnati, Ohio, April 13-17, 1942.

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NEWS AND COMMENT

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GENERAL MOTORS Corporation's employees' hospitalization plan has been extended to permit inclusion of their wives and dependent children. The benefits were originally made available on July 1, 1939, and, as of August 1, this year, 275,868 employees were enrolled, of whom 46,514 had received hospital or surgical care. The plan for employees' families will become effective November 1 for employees in Michigan, through the Michigan hospital service and the Michigan medical service. Similar arrangements will be made in other states where satisfactory hospital and medical service plans are in operation. Employees, under the plan, contribute 75 cents monthly and are entitled to a $4 daily hospital benefit, an allowance for special hospital service and an allowance for surgical cost up to $150.

Nunc pro Tunc

AT THE Symposium on Industrial Medicine and Occupational Diseases, at the Fifth Annual Convention of the National Association of Coroners, Chicago, September 17, 1941, there were three papers of preventive interest. The first two are obviously so designed; the third suggests the possibility of diagnosis *nunc pro tunc*.

DR. WILLIAM D. MCNALLY, Toxicologist of the Cook County Coroner's office, talked on "Phenobarbital and its Derivatives." "Thirty years ago the poisons which caused the most deaths were alcohol, carbon monoxide, and carbolic acid. In recent years, however, it has been the barbituric drugs—the sleep inducers such as veronal, luminal, and nembutal — which have brought an increasing number of deaths, both accidental and suicidal. These deaths are all due to one thing—the absolute lack of any restrictions on over-the-counter sale of these drugs. Any drug store sells them, in any quantity. This is true in 20 other states besides Illinois."

DR. MILTON KRONENBERG, Chief of the Industrial Hygiene Section, Department of Health, State of Illinois, treating of "Solvents in Industry," gave an extensive discussion of different types of volatile solvents used in industry and pointed out the special dangers and effects of the most common ones, with suggestions for control measures.

DR. C. O. SAPPINGTON, Industrial Consultant, Chicago, spoke on "Dust Problems in Industry," showing how the coroner, as a pathologist, and associated with other pathologists, can be of great help in assisting the practitioner in medicine to put the proper anatomic diagnosis on death certificates. This talk was illustrated by three case histories, chosen from a number of experiences in medicolegal work, each supplemented by pathological findings which disclosed in each that the death certificate had been erroneously signed as to cause of death.

The Boss, Too....

DR. RUSSELL M. WILDER, of the Mayo Clinic, has propounded the interesting theory that lack of thiamine in the diets of workers and employers alike contributes importantly to industrial unrest. He bases his theory upon his experimental findings at the Clinic that unwillingness to work, sloppiness and disagreeableness could be brought about by deprivation of thiamine. Moreover, Wilder believes that the notable lack of thiamine in such diets accounts for many industrial accidents, since such deficiency engenders worry, fear, anxiety and inattentiveness. The remedy is to see to the restoration of lost elements in our edible fats, polished rice, refined sugar and processed corn meal. Not artificial enrichment, but restoration, should be the aim. We venture to say that some of the social unrest that the world is witnessing is traceable to the same cause. So on the one hand we have the discontented, anti-social element among the workers, and on the other hand inept employers, and the weird politicians who disgrace some of our governmental bodies.—Editorial in *Medical Times*, August, 1941.

Industrial Medicine Committee

THE Canadian Medical Association at its annual meeting in Winnipeg in June established a Committee on Industrial Medicine with Dr. John G. Cunningham, Toronto, as chairman. Its purposes in general were said to be to survey the situation and define the scope and objectives of industrial medicine, to consider the qualifications and training of physicians and nurses for services in this special branch and to take stock of the personnel and training situation. It was recommended that facilities be

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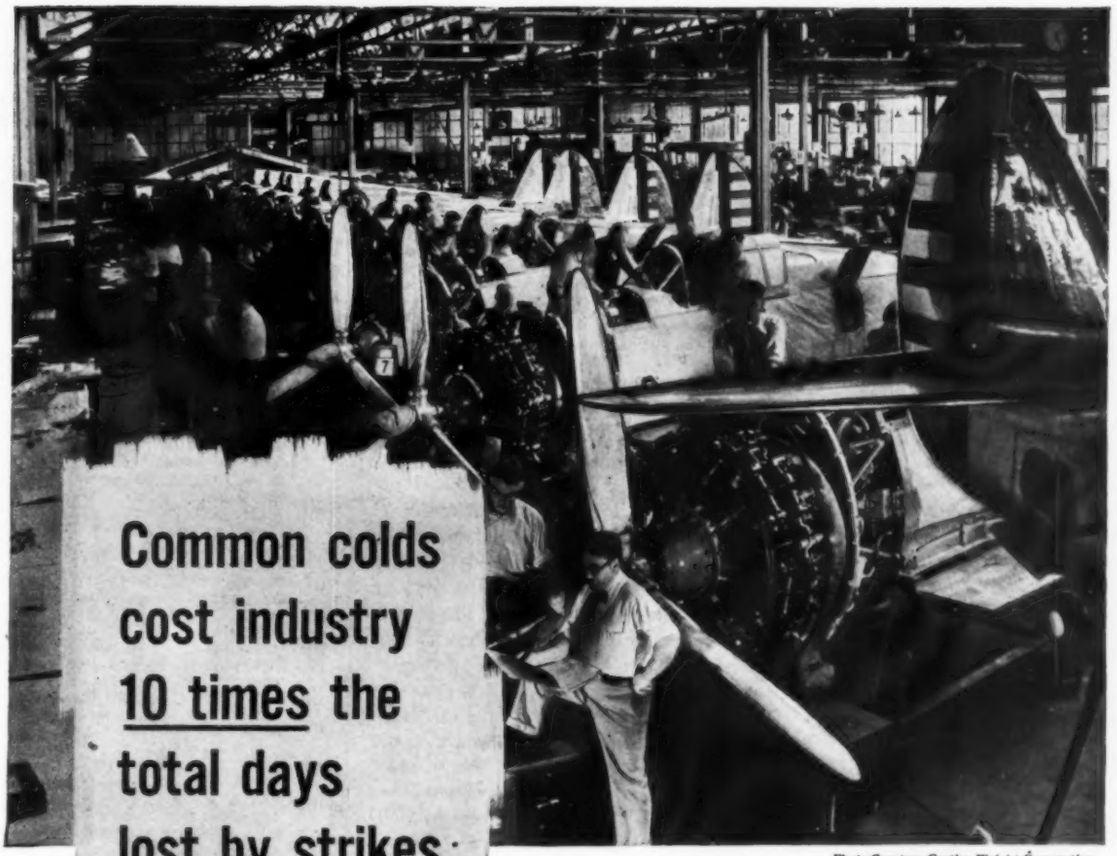

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Common colds cost industry 10 times the total days lost by strikes

Don't let COLDS keep defense workers from their jobs

The common cold and its complications will shortly begin to rob industry of precious "man hours." The U. S. Public Health Service estimates that more than 90 million work days will be lost this year due to the common cold. This is more than 10 times the total days lost by strikes in 1940.

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established in war industries for pre-employment examination of workers, medical supervision of conditions of work and special examination of those already employed for early diagnosis and control of disease and maintenance of health. —*J.A.M.A.*, September 27, 1941.

Requiescat....

A LETTER mailed from our office on December 2, 1940, to: "Societe Anonyme Andre Citroen, 143 Quai de Javel—Service Medical, Paris XVe, France," was returned to us on September 22, 1941, with the rubber-stamped legend, "Retour a l'envoyeur Relations Postales Interrompues."

Good Idea

A "REST BREAK" is not a holiday scheme, although a carefree and informal atmosphere is maintained. Neither is it a convalescent scheme, and the words "patient" or "case" are studiously to be avoided in relation to workers who participate in it. It is based on the principle that two weeks' "rest break" in the right surroundings may save six weeks' loss of production through illness, to say nothing of the mental consequences of a complete breakdown in health that may otherwise take place. It is extremely important not to confuse this scheme with the many which already exist both for holidays or convalescent treatment . . . . Out of a special fund allocated by the Council to send bombed out families and individuals away to holiday hotels and convalescent homes, the Council has agreed to help finance industrial workers from the Merseyside area who are certified by the works doctor or the Council's medical referee to be in need of a "rest break." These workers will be sent to the "Rest Breaks" Hostel. It is, of course, expected that the employers, works benevolent funds, and other agencies will help workers who may have special financial needs, but nevertheless the organization is self-supporting and is within the compass of most women and girl workers . . . . The objects may be summarized briefly as follows:

1. To anticipate breakdown in health due to overwork and undue strain and, hence,

2. To increase productive capacity.

3. To establish more firmly the principle of prevention in the care of the health of industrial workers.

4. To encourage workers, managements, and public and voluntary organizations in the great effort that is now being made.

Thus, amid the terrible exigencies of war it may be possible to formulate in practical terms the kind of facilities which should characterize a genuine new order, and actually to lay down the foundations of its future structure.—EDWARD W. FOX, in *Labour Management*, London, England, July-August, 1941.

Life Begins at....?

WHEN provisions were made for old-age assistance, statisticians informed those responsible that there would never be a time when more than 75,000 clients would be receiving aid in Illinois. Plans were made with that maximum figure in mind, yet in 1941 we are informed that more than 145,000 old-age assistance clients are receiving aid, with applications on file from several thousand others who have attained 65 . . . Many practitioners of the present era can well remember the development of pediatrics, orthopedics, radiology and a number of the other present-day important branches in medicine. It seems logical to believe that within a relatively short time we will see an increasing number of men in medicine devoting their entire time to the care of the aged, or to the subject of geriatrics . . . Perhaps when we see more physicians interested in geriatrics, we will find many more people in this country self-supporting and not in need of Federal and state aid when they attain age 65. —From an editorial in *Illinois M. J.*

JOSEPH HENRY WHITTLESEY celebrated his 93d birthday here today by working eight hours making kitchen strainer frames at his bench at the Washburn company, manufacturers of cooking utensils. He said he'd been working only five hours a day since Christmas, in compliance with his family's wishes, but he always stays eight hours on Friday, because it's pay day. Mr. Whittlesey, a slight little man with a small white beard, recalled that he worked 10 hours a day when he began his career as machine operator 21 years ago—when he was only 72. He operates two machines and a round-end lever now.—*From a Rockford, Illinois, newspaper item.*

Cooperation

MR. HARRY A. NELSON, director of Workmen's Compensation of the Industrial Commission of Wisconsin, comments as follows: "The Industrial Commission is highly pleased with the activities of the State Medical Society during the past year in cooperating with the commission in the matter of its physical examination program. This

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Absenteeism in Wisconsin

DR. PAUL A. BREHM of the State Board of Health, Madison, Wisconsin, has a series of short articles running currently in *Wisconsin Medical Journal* under the heading, "Keep the Worker on the Job." The following is from the fifth of the series, (August issue) on absenteeism in Wisconsin.

"Absentee studies conducted during 1940 have verified the findings of similar studies carried out in different types of Wisconsin plants during 1939. Analysis of the findings for 1940 again demonstrates the excellent record achieved in Wisconsin industries. A comparison of the data for 1939 and 1940 clearly indicates the trends of time loss for all types of disabilities. During the 1939 absentee study, only male wage earners in certain types of industry were included. The 1940 study, however, not only represented an entirely different type of industry but included both male and female em-

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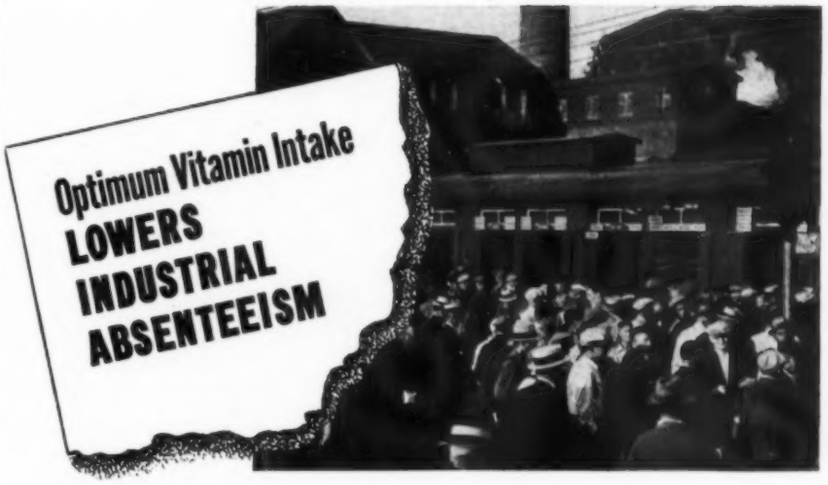

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ployees as well. The number of male workers studied in 1940 was about twice that of the 1939 study. It is interesting to note that a comparison of the absenteeism among male workers only was almost identical for the two years. In both studies the time loss due to illnesses was slightly in excess of 10 times greater than time loss due to industrial accidents. The average time loss per employee per year due to illness alone was 2.82 days in 1940 as compared with 2.25 days in 1939. This represents a slight increase over 1939. It is still well below the average found by the U. S. Public Health Service study conducted annually in a large section of the nation."

From the Archives

INDUSTRIAL medicine after many years of a tolerated existence is at last coming into its own. Its recognition is due not to the employment of bombastic methods or the assumption of "holier than thou" attitudes, but because its devotees, and I use the word devotees with premeditation, have gone ahead and done those things unusually well

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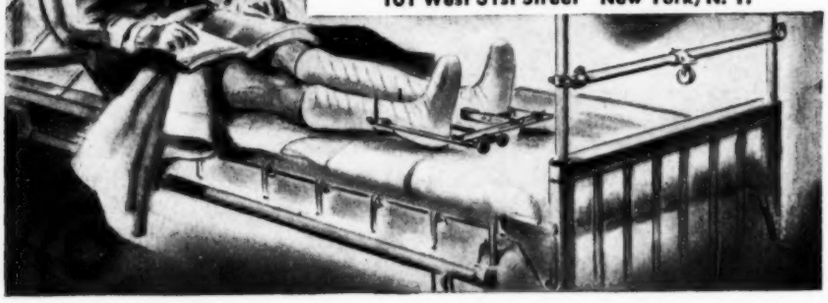

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that industry has required of them and gradually and subtilely proved their superior ability, over that of the general practitioner or any other group of medical men, in solving the medical problems of industry.—The *Bulletin* of the AMERICAN ASSOCIATION OF INDUSTRIAL PHYSICIANS AND SURGEONS, September, 1930.

Vitamin Future

IT'S pretty difficult to reduce to simple words what Dr. Robert R. Williams, chemical director of the Bell Telephone Laboratories, New York, talked about in an address on 'The Social Implications of Vitamins.' Anyway, he said the science of nutrition may provide mankind with a tool for consciously controlling and directing its evolution, a process previously governed by cosmic forces outside man's control. The decadence of nations is traceable in part to impairment of food by advancing artificialities, he said."—Newspaper comment re University of Chicago 50th Anniversary scientific presentations.

Hearing Tests

THE following appears in the current report of the Committee on Conservation of Hearing of the American Academy of Ophthalmology and Otolaryngology:

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industrial medical services and recommendations for their improvement; to solicit, receive and administer funds for any purpose that will advance and/or improve industrial health; to establish undergraduate and/or post-graduate courses in industrial medicine and surgery and/or to cooperate with medical schools and industries in maintaining such courses; and to use all those means, which from time to time, may seem wise, for the advancement of industrial health.

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"There is a noticeable increase in interest among employers of labor in conservation of hearing among employees. This committee recommends that hearing tests by acceptable audiometers be included in the pre-employment medical examination of every applicant for a position and at suitable intervals thereafter. This procedure could profitably be made a universal practice in all lines of work, including, under present circumstances, the civil and military activities carried on by the Federal government."

New Department

INDUSTRIAL HEALTH is the title of a new editorial department appearing in *Minnesota Medicine*, beginning with the August, 1941, issue. "By courtesy of the Editorial Committee, and with the approval of the Council, one page in each issue will henceforth be reserved for publication of practical information to physicians in the field of industrial health."

Flying Aptitude

IT SHOULD be pointed out that the examination for the selection of flying personnel is more than an inventory of physical findings. It is an evaluation of the man as a whole including an estimation of his special suitability for a task in a new environment. It must include a careful analysis of the nervous, mental, emotional and temperamental make-up of the individual. Flying subjects man to unfamiliar environmental factors and places under his control a strange and powerful force which greatly taxes his resources. It creates thereby a new experience which is capable of providing an extraordinary test of his adaptability. Naturally, the candidate must pass a good physical examination. It is thorough, and generally not different from the regular examination required for officer personnel. But it is now known that successful flying in the military service involves more than that. It calls for a high order of physical endowment, and a peculiar neuropsychic make up. This latter requirment is more difficult to analyze. The entire examination is rigid, and I think the reasons should be obvious. It might be stated here that available statistics indicate that only about 20% of applicants examined during recent years were able to meet the special requirements of the physical examination. All applicants were young men of college age, and mostly college trained. Of this highly selected group of 20%, only between 40 and 50% were able successfully to complete the course in flying training. Analysis of these failures reveals that they must be due to what might be called lack of flying aptitude. Flying instructors speak of it in such terms as lack of "inherent flying ability," inability to sense the "feel of the ship," "tenseness at the controls," "lack of coordination," "mechanical performance," etc. In addition, analysis of aircraft accidents has revealed a large number to be due to such factors as errors of judgment, foolhardiness, carelessness, and disobedience to flying regulations.—From "Aviation Medicine," by G. W. NEECE, M.D., Captain M.C., Flight Surgeon, Patterson Field, in *Kentucky M. J.*, July, 1941.

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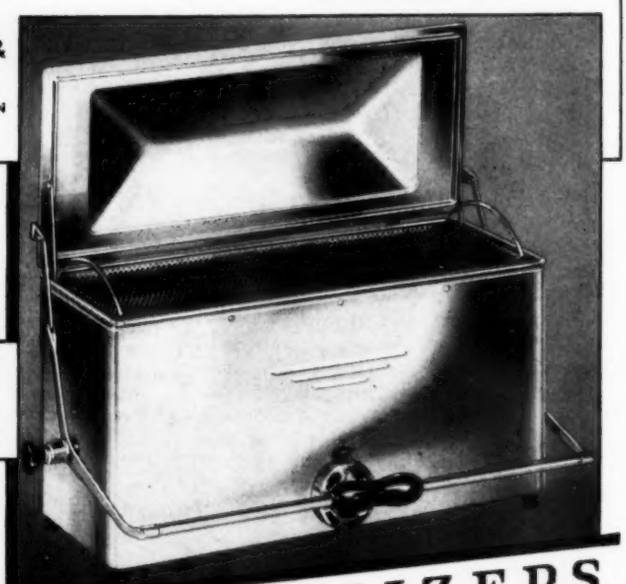

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PELTON STERILIZERS

heart and blood vessels, (6) the kidneys, and (7) the reproductive system (the germ cells). For this reason the symptoms of lead poisoning, like those of syphilis, may be very diverse and may be referable to almost any organ of the body. Unless lead poisoning is thought of (and this is most unlikely unless an accurate and complete history is taken, including the occupational history in detail) a particular case may be mistaken for almost any disease known of in medicine. And this has occurred over and over again. Cases of lead poisoning with lead colic have been diagnosed and operated on as cases of acute appendicitis, acute intestinal obstruction, and acute gall-bladder disease. Patients with lead encephalitis (inflammation of the brain) have been operated on under the incorrect diagnosis of brain tumor. Recently a patient was sent to and even died in an insane asylum as a case of insanity, having never been diagnosed or treated as a case of lead poisoning. Why do such mistakes occur? The chief reason is because the average general practitioner sees so few cases of industrial or occupational diseases in his practice. Therefore he is likely to fail to think of an industrial or occupational exposure in any particular case.—DAVID C. STRAUS, M.D., *Chicago, Illinois M. J.*, 3:247-249, 1941.

Allowable Concentrations

AMERICAN STANDARDS ASSOCIATION (29 West 39th Street, New York City) has issued American Standards covering four gases and vapors, as follows:

CARBON MONOXIDE: "The maximum allowable concentration of carbon monoxide shall be 100 parts per 1,000,000 parts of air by volume with atmospheric oxygen not below 19% by volume for exposures not exceeding a total of eight hours daily and shall be 400 parts per 1,000,000 parts of air by volume for exposures not exceeding a total of one hour daily."

HYDROGEN SULFIDE: "The maximum allowable concentration of hydrogen sulfide shall be 20 parts per 1,000,000 parts of air by volume for exposures not exceeding a total of eight hours daily."

CARBON DISULFIDE: "The maximum allowable concentration of carbon disulfide shall be 20 parts per 1,000,000 parts of air by volume for exposures not exceeding a total of eight hours daily."

BENZENE: "The maximum allowable concentration of benzene (benzol) shall be 100 parts per 1,000,000 parts of air by volume for exposures not exceeding a total of eight hours daily."—E. C. BARNES, in *Westinghouse Safety News.*

True

NOTICING a news item about the proposed New Zealand law, we were dipping the pen in vitriol and getting ready for a stinging comment when the following came along by way of an editorial in *Chicago Daily News*, September 10, 1941, under the heading, "You Get What You Pay For":

"Capping a half century of radical lawmaking, the New Zealand parliament is now considering a bill to limit doctor's fees to $1.25 per physician's visit. The state is to pay medical fees for the people and the doctor will collect from the government, not the patient.

"New Zealand will pay the doctor a dollar and a quarter and that means that eventually the doctor's services will be worth no more than one dollar and twenty-five cents. When the present generation of competent doctors are all dead we may be quite sure that the profes-

sion will be manned by bargain-counter docs. Laws may regulate a doctor but no laws can compel a competent man to become a doctor. We trust that there will be enough horse doctors in New Zealand to take care of the asinine population that must be increasing rapidly under Herbert Spencer's old formula: 'The net result of passing laws to protect fools from the consequences of folly is to fill the world with fools.'"

MEETINGS

New York Central Surgeons

THE ASSOCIATION OF SURGEONS OF THE NEW YORK CENTRAL SYSTEM is holding its 18th Annual Meeting at the Commodore Perry Hotel, Toledo, Ohio, October 7, 8 and 9, 1941. The program, prepared by the Committee under the chairmanship of DR. N. W. GILLETTE, includes the following:

"Entrance and Return to Service Examinations"—DR. GEORGE P. MYERS.
"Treatment of Compression Fractures of the Upper Tibia"—DR. LEONARD A. ENSMINGER.
"The Medical Witness"—Presidential Address—DR. BRADLEY L. COLEY.
"Angina Pectoris"—DR. FRANK CLIFFORD.
"Some Principles in the Treatment of Low Back Pain"—DR. MAX SCHNITKER.
"Hemorrhage from the Urinary Tract and Its Significance"—DR. E. BENJAMIN GILLETTE.
"The Relation of Roentgen Findings to Clinical Evidence"—DR. CLARENCE HUFFORD.
"This Thing Called Allergy"—DR. KARL FIGLEY.
"Plastic Surgery of Eyelids and Nose"—DR. WILLIAM A. LANGE.
"Round Table Discussion of Revised Visual Regulations"—MR. OLIVER G. BROWNE.
"Cancer and Pre-Cancer of the Skin and Lip"—DR. HOWARD PARKHURST.
"Fractures about the Ankle"—DR. EDWARD P. GILLETTE.
"The Value of Peritoneoscopy"—DR. CHARLES A. LAMB.
"Indications for Surgery of the Gastro-Intestinal Tract"—DR. MILTON A. STRAWBRIDGE and DR. NORRIS W. GILLETTE.
"The Cardiac Patient as a Surgical Risk"—DR. H. CAMPBELL HAYNIE.
"The Value of Blood Examinations in Routine Practice of Medicine"—DR. FOSTER MYERS.
"The Importance of Thorough Examinations and Submission to the Claim Department of Accurate and Complete Reports of Injuries"—MR. HARRY G. WHITEMAN.
"Criteria of Malignancy"—DR. ALLEN GRAHAM.
"Foreign Body Granulomata"—DR. A. H. SCHADE.

Military Surgeons

THE Association of Military Surgeons of the United States is holding its Annual Meeting, October 29—November 1, at the Brown Hotel, Louisville, Kentucky. "Mechanization of armies and air bombardments have created new and difficult problems in traumatic surgery and methods of treatment of wounds and extreme abrasions."

Community Social Hygiene

IN conjunction with the 20th Annual Meeting of the American Public Health Association at Atlantic City, October 13 to 17, the American Social Hygiene Association is holding its Community Social Hygiene Meeting, in the Hotel Traymore, on Sunday evening, October 12. The meeting will be devoted to discussion of venereal diseases in relation to national defense industries, and is co-sponsored by the New Jersey Health Department, Social Hygiene Conference, and Health and Sanitary and Tuberculosis Associations, and the Atlantic City Health Department and Visiting Nurses' and Tuberculosis Associations.

Georgia Industrial Surgeons

GEORGIA INDUSTRIAL SURGEONS ASSOCIATION is having its Fourth Annual Meeting at the Cloister, Sea Island, Georgia, on September 27, 1941. Among the features of the program are the following presentations.

"Disc Lesions"—DR. EXUM WALKER.
"Industrial Medical Education"—DR. FRANK ESKRIDGE.
"Research in Industrial Medicine"—DR. JOHN L. JACOBS, President, Oglethorpe University School of Medicine.
"Vertebral Fractures"—DR. JOE BOLAND.
"Industrial Surgeons as Seen by Insurance Attorney"—JUDGE SHEPHARD BRYAN.
"Un-united Fractures"—DR. FRED H. ALBEE.
"Crusade for Better Industrial Surgery"—DR. R. L. RHODES.

Industrial Hygiene Courses

THE University of Pennsylvania offers a course of instruction, of 12 weeks' duration, in Industrial Hygiene (October 27, 1941, to January 17, 1942). The course will be given under the auspices of the Engineering, Science and Management Defense Training Program of the U. S. Office of Education and is open to graduates in engineering, chemistry or allied sciences. Subjects covered include: Principles of industrial

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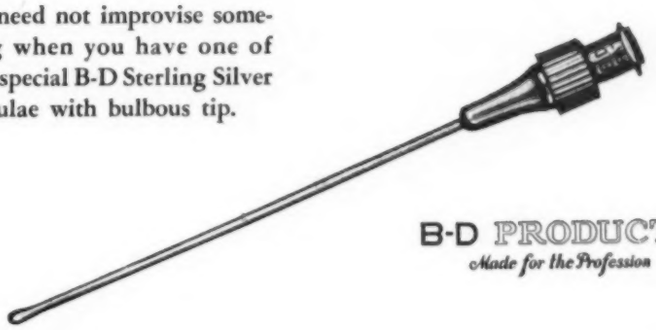

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hygiene, industrial hygiene laboratory methods, industrial ventilation, safety engineering, administration of industrial health services, industrial psychology and statistical methods. Applications for admission should be addressed to: THEODORE HATCH, Associate Professor of Industrial Hygiene, Department of Public Health and Preventive Medicine, University of Pennsylvania, Philadelphia.

TO MEET the increasing need in the National Defense Program for trained workers in the field of industrial health and accident prevention, two special courses for insurance and industrial engineers, industrial nurses, inspectors, and other interested persons will be conducted during the fall term beginning early in October by the New York University Center for Safety Education. A course in "Industrial Hygiene and Occupational Diseases" dealing with modern methods and techniques of industrial hygiene, accident prevention, and health education will be given Mondays at 6:00 P. M. beginning October 6 in the assembly room at 60 John Street. A second course entitled "Industrial Hygiene and Accident Prevention for Nurses" and designed to aid the industrial nurse in improving and protecting the health of workers will be conducted Tuesdays at 6:00 P. M. beginning October 7 in the seminar room of the Center for Safety Education at 8 Fifth Avenue. Each of the Center's courses will consist of 15 two-hour lecture-discussion and demontration periods by experts.

Industrial Hygiene Foundation

INDUSTRIAL HYGIENE FOUNDATION (formerly Air Hygiene Foundation) will hold its Sixth Annual Meeting at Mellon Institute, Pittsburgh, on November 12 and 13, 1941. Recent progress in the protection of employee health, as well as current developments and future trends will be reported by the Foundation's Medical and Preventive Engineering Committees, headed by DR. A. J. LANZA and PROF. PHILIP DRINKER, respectively. T. C. WATERS, General Counsel, will report for the Legal Committee. The Medical section of the program will include the first report on the Foundation's study of Sick Absenteeism in Industry. This was started this year with the collaboration of the U. S. Public Health Service and the AMERICAN ASSOCIATION OF INDUSTRIAL PHYSICIANS AND SURGEONS. A number of the Foundation's member companies have been keeping monthly records of their sick absenteeism experience. This first report from this data will be made by DR. W. M. GAFAFER, Senior Statistician, U. S. Public Health Service. ANDREW FLETCHER, Vice-President and Treasurer, St. Joseph Lead Company, will give an economic interpretation of the findings. DR. LANZA will report on his recent visit to Canada where he and other industrial health specialists studied the Canadian experimental work on the use of aluminum to combat silicosis. This will also be discussed by one of the Canadian physicians and by DR. L. U. GARDNER, Director of Saranac Laboratory. Results of medical research supported by the Foundation at The Saranac Laboratory and the University of Pennsylvania will also be reported. Findings from the Foundation's researches in preventive engineering at the Harvard School of Public Health and at University of Pennsylvania will be analyzed. Engineering control of hazards arising out of this period of expanding industrial production will be dealt with by noted authorities. This will include the complicated problems caused by substitutions in manufacturing materials. A discussion is planned on "Trends Toward Compensation for Tuberculosis as an Occupational Disease?" DR. R. R. SAYERS, Director, U. S. Bureau of Mines will discuss the new Mine Inspection Act. A three-way discussion of the role of industrial health in industrial relations will be presented by a representative of management, labor and government. Attention will also be devoted to the protection of the work-a-day population under wartime conditions.

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Iowa Industrial Institutes

THE Special Institutes on Industrial Health, sponsored by the Iowa State Department of Health in cooperation with local medical societies, were so successful in their first series and were so well attended that three more were given — at Council Bluffs, September 22, at Waterloo, September, 23, and at Dubuque, September 24. The following were presented at each meeting.

"Medical Control Measures in Industry"—C. O. SAPPINGTON, M.D., DR. P. H.

"Industrial Hygiene Survey Methods"—PAUL J. HOUSER.

"Venereal Diseases in Industry"—REGNAR M. SORENSEN, M.D.

"Management of Industrial Injuries" — WILLIAM R. CUBBINS, M.D.

"Human Serum (pooled) in Shock and Hemorrhage"—EUGENE C. WAGNER, M.D.

"Occupational Diseases in Iowa"—CAREY P. MCCORD, M.D.

"Care of Industrial Back Injuries"—DONALD C. CONZETT.

"Organization and Costs of Medical Services in Industry"—CAREY P. MCCORD, M.D.

"Medico-Legal Phases of Occupational Diseases"—C. O. SAPPINGTON, M.D., DR. P. H.

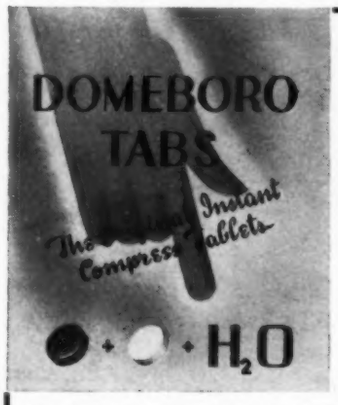
"The Industrialist's Viewpoint" — R. J. FISHER.

Alabama

THE ALABAMA STATE ASSOCIATION OF RAILROAD AND INDUSTRIAL PHYSICIANS AND SURGEONS held its Annual Meeting on September 30, 1941, at the Tutwiler Hotel, Birmingham.

New York

THE ASSOCIATION FOR THE ADVANCEMENT OF INDUSTRIAL MEDICINE AND SURGERY is having its Annual Dinner in the Georgian Room of the Hotel Pennsylvania, New York City, October 23, 1941.



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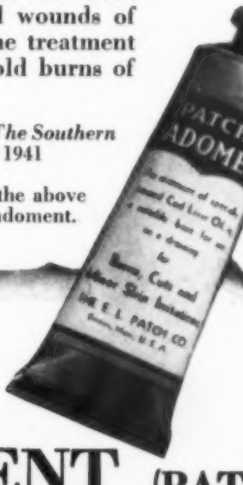
*Levin, O. L., and Behrman, H. T.: *Industrial Medicine*, Feb., 1941

"Cod liver oil ointment is recommended as a superlative method of local wound therapy applicable to both clean and infected wounds of all types and in the treatment of both new and old burns of major severity."

—*Hardin, Parker C.: The Southern Surgeon, May* 1941

The ointment used in the above report was Patch's Gadoment.



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(CASE X: Deep electrical burn of forefinger)

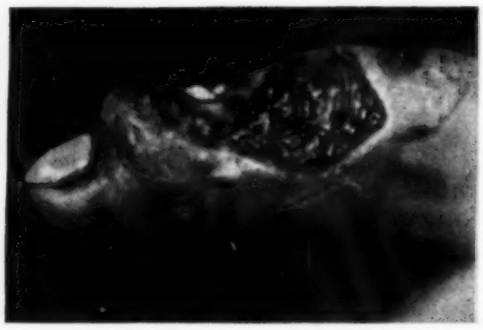

FIGURE 1: Lateral view of deep burn of left forefinger caused by 11,000 volt shock. The appearance of the lesion at 3 weeks is demonstrated, showing the deep destructive process typical of severe electrical burns. The extensor tendon has sloughed out, the distal interphalangeal joint has been fully exposed and amputation appears necessary.

FIGURE 2: Appearance of injured finger 4½ weeks after Figure 1. Treatment during intervening period consisted of dressings—changed infrequently—with White's Vitamin A and D Ointment, and the use of a finger splint. In response to this therapy, sloughing quickly cleared up and granulations filled in the extensive defect over exposed bones. Complete healing, as shown, was accomplished without complicating infection 4½ weeks after Figure 1 and 7½ weeks after the injury.

Reproduced through courtesy of Dr. P. C. Hardin and *The Southern Surgeon*

FOLLOWING industrial injuries it is obviously desirable to shorten the period of disability and hasten maximum restoration of function.

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This magazine is published to promote sound thought upon and concerning industrial medicine and traumatic surgery. To that end it will contain articles, news items, reports, digests, and other presentations, together with editors' comments. The editorial policy is to encourage frank discussion. On this basis contributions are invited.

Industrial Medicine

Reg. U. S. Pat. Off.

The editors will exercise care in checking on the accuracy of data printed, but in all other respects articles and opinions of which expression is allowed are the opinions of their authors—the editors reserving in all cases the right to comment on the same, in the current or any subsequent issues, as they may be inclined.

The Journal of Occupational Diseases and Traumatic Surgery

With which are consolidated "The Industrial Doctor" and "International Journal of Medicine and Surgery."

The Science, the Law and the Economics of Industrial Health

Volume 10 OCTOBER, 1941 Number 10

Traumatic Intracranial Hemorrhage

—With Particular Reference to Surgical Management—

E. S. GURDJIAN, M.D.,
Neuro-Surgeon, New York Central System, Detroit

TRAUMATIC intracranial hemorrhage is usually classified on the basis of its position in the cranial cavity. Frequently there is a combination of lesions, particularly since a great many cases of head injury sustain intracranial damage by indirect force or blow. To clarify this matter further, it may be said that injury to the head may be due to at least two types of force or blow. First: Direct blow or force, in which a moving object hits the non-moving or slower moving head. Second: Indirect force or blow in which the moving head, such as in a fall, automobile accident, etc., may come in contact with a slower moving or non-moving object. There is a greater likelihood of localized lesions with direct force or blow. In indirect force or blow, multiple lesions are frequent. Multiple small lesions, even in the same organ, may be brought about by the crowding together of portions of different density in the same organ, when the moving organ is suddenly halted by a non-moving or slower moving object. Petechial hemorrhages through the nervous system due to trauma can be explained on this basis.

Traumatic intracranial hemorrhage may be classified clinically as follows:—

Extradural hemorrhage, due to rupture of meningeal vessels, sinuses and diploe.

Intradural hemorrhage, due to pial tears, lacerations and bruises of nervous tissues.

1. Subdural: Acute. Chronic.
2. Subarachnoid: Generalized. Localized.
3. Intraparenchymatous: Petechial. Massive.

Subdural accumulation of spinal fluid simulating intracranial hemorrhage.

Presented at the Fifty-Second Annual Meeting of the AMERICAN ASSOCIATION OF RAILWAY SURGEONS, Chicago, September 10, 1941.

In a given case there may be and there usually is, a combination of lesions. Bruises of the brain surface may co-exist with extradural hemorrhage, subdural hemorrhage, petechial hemorrhages through the brain and so on. However, one lesion is usually predominant and its signs and symptoms as well as management are sufficiently typical to discuss the management of intracranial hemorrhage by considering each lesion separately and on its own merits.

The conditions to be discussed are the following:

1. Extradural hemorrhage.
2. Acute subdural hemorrhage.
3. Subacute and chronic subdural hematoma.
4. Massive intraparenchymatous hemorrhage.
5. Subdural accumulation of spinal fluid simulating intracranial hemorrhage.
6. Petechial hemorrhages, and
7. Subarachnoid hemorrhage.

Extradural Hemorrhage

THE most common type of extradural hemorrhage is of middle meningeal origin. Sagittal sinus extradural hemorrhage is seen occasionally. Depressed comminuted fracture near the midline of the vault and perforating wounds in this region may bring about varying degrees of hemorrhage from this source. In one of the cases studied, an ice pick perforated the sinus, causing extensive extradural and intradural hemorrhage. A large clot collected between the two hemispheres in this case and immediately overlay corpus callosum.

LATERAL SINUS. Extradural hemorrhage is frequently the result of perforating wounds. No group of symptoms and signs typical for such a condition are noted in such cases. As a rule, only

signs of increased intracranial pressure prevail. Extradural hemorrhage of occipital emissary vein origin was seen in several cases of depressed fracture posterior and superior to the mastoid region. In no cases was it felt that the clot was extensive enough to exert pressure.

Extradural hemorrhage of middle meningeal origin is the commonest type and the term Extradural Hemorrhage usually implies a lesion of middle meningeal origin. It is usually unilateral. Two cases of bilateral extradural clot have been seen in this series. One was operated upon, the other was seen at the postmortem table.

In some cases there may be relatively little involvement of the remainder of the intracranial contents but this is frequently not the case. A relatively common case of hemorrhage from the middle meningeal artery, gives typical signs and symptoms. The classic syndrome of unconsciousness, followed by a lucid interval, the latter followed by a secondary unconsciousness and focal signs may obtain. But because of associated damage to other parts of the intracranial structures many bazarre pictures are seen. These various features of extradural hemorrhage will be taken up under separate headings.

ETIOLOGY. Fall, bicycle accidents and direct blows to the head are frequently the cause of extradural hemorrhage. In a series of 158 autopsied cases, seven out of 11 were caused by such accidents. Automobile injuries (indirect blows) caused relatively few cases of rupture of the middle meningeal artery.

LUCID INTERVAL. Lucid interval is the exception rather than the rule in extradural hemorrhage. An already unconscious state becoming deeper is the usual and characteristic change seen in most instances. Lucid interval is absent because of frequent associated co-existent pathology in other parts of the nervous system, and then again, in an occasional case the hemorrhage from the artery may be so rapid as to wipe out a possible lucid interval.

OCULAR MANIFESTATIONS. The most common finding is dilated pupil on the side of the lesion. Extraocular paralyses have been seen. The enlarging clot may compress the extraocular nerve or nerves as they traverse the superior orbital fissure, or the pressure may be brought about by the bulging inner tip of the temporal lobe medially, "catching" the nerve or nerves in their intracranial course from brain stem to cavernous sinus. Dilated pupil without other signs of third nerve paralysis may be attributed to the same etiology or paralysis of the cortical pupillary constriction mechanism. In favor of the former assumption is the fact that when the clot is located at the base, pupillary manifestations are the rule, whereas, when the clot is over the parietal and temporal convexity the pupils are likely to be equal in size. The dilated pupil is almost always on the side of the lesion. A constricted pupil on the side of the lesion was seen only once in this series. Third nerve paralysis was seen in four cases.

FOCAL SIGNS. The most typical finding is weakness or paralysis of the opposite half of the body. Fully eight out of 10 show these changes. The necessity for frequent examination cannot be overemphasized. By this method changes in reflexes and the presence of a weakness or paralysis, not present previously, can be brought out. These focal signs may range from a complete hemiplegia to a pyramidal tract irritation sign without evident weakness.

X-RAY FINDINGS. X-rays of the skull do not usually help in the diagnosis of middle meningeal hemorrhage but frequently a fracture line is seen crossing the temporo-parietal region. Middle meningeal hemorrhage may be associated with a depressed fracture. This was seen in five cases in this series. Because of this association, simple depressions, even if slight, should be given close observation in the presence of continued unconsciousness and focal signs. In two cases proven by postmortem examination, the fracture was so insignificant that x-rays could not have demonstrated them. In one case of bilateral middle meningeal hemorrhage, both sides were explored because of the extensive fracture from one temple to the other. Patient was paralyzed in the right half of the body but also showed signs of pyramidal tract involving the left half.

PULSE, RESPIRATION, TEMPERATURE AND BLOOD PRESSURE. In the uncomplicated cases, the pulse rate is usually slow in the beginning (40 to 60). Respirations are within the range of normal. Blood pressure readings have not been characteristic or significant in the majority.

SPINAL FLUID FINDINGS. As a rule, the spinal fluid pressure is high but a low pressure does not rule out middle meningeal hemorrhage. The fluid in the punctured cases in this group contained blood of varying concentration. Blood in the spinal fluid does not rule out middle meningeal hemorrhage and this should be kept in mind.

PATHOLOGY. The initial hemorrhage from the middle meningeal artery grows larger not only from arterial blood but also the various venous channels of the dura and bone as the dissection proceeds. Subdural hemorrhage was seen 11 out of 30 cases. In two cases there was associated subdural accumulation of spinal fluid. Temporo-sphenoidal lobe massive clot may accompany middle meningeal hemorrhage. This was seen in three of the operated cases. The clot may be from a few to 30 to 50 grams in size.

TREATMENT. Operation of choice is subtemporal decompression on the side of the lesion. If the clot is beyond the confines of the temporal muscle and fascia, a small bone flap may be turned. Bleeding points are tied or cauterized. Usually a gauze drain is used for hemostasis. This is removed within 12 to 18 hours. The dura is opened, if necessary, to drain subdural hemorrhage or an intraparenchymatous clot. Local or general anesthetic may be used. The latter may help obliterate the "dead space" from removal of the clot by increasing the intracranial pressure.

Acute Subdural Hemorrhage

ACUTE subdural hemorrhage may be brought about by tear of pial vessels, contusions, and lacerations of nervous tissue. At times it is extensive, covering the surface of one or both hemispheres. As a rule, it is located in the fronto-parieto-temporal region of one or both sides. Occasionally unusual localization of the clot is seen. In two cases, there was an extensive subdural clot between the two hemispheres. The fronto-parieto-temporal localization and its frequency can be explained on the basis of anatomic relations of the brain and coverings in this region. The frontal, parietal and temporal lobes are snugly fitted into a bony incasement with many propecting parts and irregular surfaces. In indirect blows when the moving head hits a non-moving or slower moving object, the intracranial contents abut against this irregular bony incasement with ensuing bruises and tears.

THE STATE OF CONSCIOUSNESS. The state of consciousness may manifest changes comparable to those found in extradural hemorrhage. Lucid interval may obtain and is seen almost as frequently as in middle meningeal hemorrhage. Lucid interval may vary from a few hours to several days or months. As a rule, the longer the period free of symptoms, the better the prognosis in such cases. Most frequently patients with acute subdural hemorrhage with signs, remain unconscious throughout with increasing stupor and coma. Frequent examinations may reveal a duller reaction to pain or other stimuli. As a rule, a case of subdural hemorrhage with signs looks very ill from the beginning.

OCULAR MANIFESTATIONS. Pupillary inequality and extraocular paralysis may be seen. A dilated pupil if present, usually is on the same side as the lesion. The same is true of a unilateral extraocular paralysis. The examination of fundi may show beginning choking of discs, particularly in subacute or chronic forms, but this is uncommon.

FOCAL SIGNS. Increasing drowsiness and unconsciousness may be the only finding in rare cases but as a rule, accompanying the change in the conscious state, there are localizing signs varying from a Babinski to a complete paralysis of one or more limbs. In cases with extensive and rapid hemorrhage, changes occur quickly. The slower the onset of signs and symptoms and their progress, the better the prognosis.

X-RAY FINDINGS. There may be a fracture on the same, on the opposite side or in the occipital and frontal regions, or there may be no fracture shown in the x-rays or postmortem. The presence of a fracture line does not locate the pathology in cases of acute subdural hemorrhage.

PULSE, RESPIRATION, TEMPERATURE AND BLOOD PRESSURE. Early the pulse rate may slow down, but it tends to go up more quickly than in cases of extradural hemorrhage. Respirations may be elevated from the beginning. Occasionally the blood pressure may rise with increasing stupor but as a rule, it shows little or no change.

SPINAL FLUID FINDINGS. The fluid is usually bloody, its pressure may be high, but can be very low. To prognosticate by the color of the spinal fluid alone is dangerous and may allow the exitus of cases that could survive after operative relief.

PATHOLOGY. As a rule, tear of pial vessels is the source of subdural hemorrhage. Occasionally, a massive intraparenchymatous clot may tear through the brain surface and seep into the subdural space. The latter is more common in non-traumatic cases. Contusions and tears of neural tissues may accompany pial tears. Deeper lesions, multiple small hemorrhages may be seen. In fact, these complicating lesions are frequently the cause of prolonged disability or death. The subdural hemorrhage may be so small that it may never cause symptoms and signs. Depending upon its initial size, there may be a lucid interval of hours or days, or due to a tear of a large pial vein, there may be practically instantaneous signs and symptoms. In the more chronic forms, the absorption of tissue fluids and spinal fluid by the clot may enhance its activity. Almost immediately reactive changes and connective tissue proliferation on the inner aspect of dura are started. In a subacute or chronic form, this may eventuate in a distinct membranous lining immediately under the dura and covering the clot.

TREATMENT. Acute subdural hemorrhage with signs usually necessitate operative intervention. Both sides should always be explored. A trephine opening at the fronto-parietal junction 2 in. on either side of the midline should uncover the greatest majority of cases of acute subdural hemorrhage. If the initial openings are negative, air studies may be worth while. If subdural hemorrhage has been located on one or the other side, a subtemporal decompression is performed on the side of the lesion. The clot may be worked out by forcing saline into the trephine opening and allowing it to come out at the subtemporal decompression. The subdural space is drained from 12 to 18 hours.

Subacute and Chronic Subdural Hematoma

WHEN hemorrhage into the subdural space is small in amount or if it is of a size not jeopardizing the spacial relationship in the cranial cavity too much, such pathology may cause no or few symptoms for several days or weeks or longer. With osmosis and diffusion of spinal fluid and other tissue fluids, into the blood clot (with high solid contents), the subdural mass slowly grows in volume until it is of a size to cause symptoms. This growing mechanism also can be helped by occasional hemorrhages into the clot from the vessels in the proliferating granulation tissue on the dural side. It is in this manner that the frequently seen asymptomatic interval and onset of symptoms can be best explained.

ETIOLOGY. Chronic subdural hematoma may follow insignificant trauma to the head. In some cases the trauma may be entirely forgotten by the patient and his people. On the other hand, severe

brain injury may accompany this condition. In such cases there may be fracture of the skull and disability from the time of trauma.

THE STATE OF CONSCIOUSNESS. In the typical case the patient may be normal for several days or weeks. If chronic subdural hematoma complicates severe head injury the patient may remain unconscious or semi-conscious for several days or weeks and he may lapse from the unconsciousness caused by the severe brain injury to that caused by the enlarging subdural hematoma, without interruption. A great many in this series had associated severe trauma to the brain.

OCULAR MANIFESTATIONS. Pupillary inequality is seen occasionally. The dilated pupil is usually on the side of the lesion. Extraocular paralysis may obtain in the advanced cases. If not bilateral the paralysis is almost always on the side of the lesion. Fundi may show choking of discs but this is the exception rather than the rule. Visual fields in those that can cooperate, have been of little help.

FOCAL SIGNS. Headache is about the most constant complaint and it is usually on the side of the lesion. Increasing drowsiness and coma may be the only findings in some cases. As a rule, focal signs obtain in the more advanced cases. In chronic subdural hematoma, bilateral signs and signs implicating the "wrong side" are common and should be watched for.

X-RAY FINDINGS. There may or may not be a fracture of the skull. As a rule, the condition follows minor trauma to the head so that a majority show no fracture. Air studies are very helpful and patients with subdural hematoma tolerate such procedure surprisingly well. If the ventricles are visualized there is a midline shift and air over the convexity of the hemisphere on the affected side is characteristically absent. If the ventricles are visualized there is a midline shift, and air over hemisphere may be significant. A column of air may show medial to the hematoma and this column may appear like a "pointer" within the cranial cavity. This is pathognomonic of a subdural hematoma. In the presence of fracture of the skull, the hematoma need not be on the same side as the fracture although this is often the case.

PULSE, RESPIRATION, BLOOD PRESSURE AND TEMPERATURE. If one has had the opportunity to see the case from the beginning, a lowering pulse rate with a transient period of unconsciousness may be the only sign of the acute bleeding into the subdural space. Among those with a long interval history, the vital functions are usually quite normal except with the onset of signs and symptoms. A lowering pulse rate followed within two or three days by an increase in the rate is characteristic. Blood pressure readings are usually normal throughout.

SPINAL FLUID FINDINGS. The fluid may be clear or xanthochromatic; the pressure is usually elevated. However, a low pressure does not rule out a subnormal hematoma.

PATHOLOGY. Depending upon the size of the hemorrhage in the subdural space there may be varying periods of asymptomatic interval. At the time of active hemorrhage there may be associated unconsciousness, disorientation or headaches followed by rapid recovery and the onset of the asymptomatic stage. At times the hemorrhage may be ushered in so insignificantly that the patient and his people may completely forget the causal factor, (fight, blow or other accidents) and then again the pure clot may be sufficiently large to cause immediate symptoms and signs. In the genesis of chronic subdural hematoma the following pathological changes occur:—Almost immediately there is inflammatory reaction and connective tissue proliferation on the side of the subdural mass. On the arachnoid side only a limiting membrane forms. The subdural mass limited by arachnoid membrane on its inner aspect grows larger by absorbing tissue fluids and spinal fluid through diffusion and osmosis. The size of the subdural mass may be enhanced also by repeated small hemorrhages into the clot from rupture of small vessels in the reactive and inflammatory tissue on the dural side. In this way the asymptomatic interval is eventually interrupted by symptoms and signs of increasing intracranial pressure. Within the sac the blood clot may hemolyze partially or completely. In unusual cases curiously enough, the clot remains practically completely solid.

TREATMENT. Bilateral trephination at the fronto-parietal junction about 2 in. on either side of the midline with subtemporal decompression on the side of the lesion, is the method of choice if the clot is mostly fluid. A small osteoplastic flap is used if the clot is mostly solid. A single or two trephine openings may be sufficient to drain the subdural cyst with complete success. It is now generally admitted that leaving in the outer membrane of the subdural hematoma is harmless in itself. The above described relationship of a sac surrounded with tissue fluids and separated from them with a semi-permeable membrane (the arachnoid) does not seem to re-establish itself once the skull and the clot have been opened.

Massive Intraparenchymatous Hemorrhage

MASSIVE intraparenchymatous hemorrhage or intracerebral hemorrhage in acute head injury is an uncommon observation. The most vulnerable spot seems to be the region of the temporo-sphenoidal lobe. In 158 consecutively autopsied cases, there was only one instance of massive intracerebral clot located lateral to the thalamus and extending into the temporo-sphenoidal lobe. Clinically the same rarity of such cases is evident. In our series of around 400 operations for head injury, there have been three instances of massive intracerebral clot. Curiously enough, they all occurred in the left temporo-sphenoidal lobe.

The findings obtained were the same in each instance. A progressive course of three to seven days characterized by right lower facial weakness, right upper limb paresis, eventual aphasia and stupor, were seen. Because of the localizing signs, a left subtemporal decompression was per-

formed and in each instance a massive clot from the temporo-sphenoidal lobe with an overlying subdural hemorrhage was evacuated. Much necrotic brain tissue was encountered, most of which was removed with care.

In the diagnosis of such cases, localizing neurological signs and in the more puzzling instances, air studies, should locate the lesion accurately.

Subarachnoid Hemorrhage

SUBARACHNOID hemorrhage is the most common variety of traumatic intracranial hemorrhage. It may co-exist with epidural, subdural and intraparenchymatous hemorrhage. Almost any type of lesion of the brain may cause associated subarachnoid hemorrhage but it is usually brought about by contusions of brain surface and pial tears. At times it is extensive enough to cover one or both hemispheres. The diagnosis is clinched by a lumbar puncture. The fluid obtained from the spine may contain much less blood than from the cistema magna or the ventricles. Localized subarachnoid hemorrhage with edema may cause focal signs of such progressive course that it may resemble closely the picture of massive intracranial clot. The presence of blood in the spinal fluid should not deter operative intervention for in cases of epidural and subdural hemorrhage there is almost always associated subarachnoid hemorrhage and to blame the clinical picture on the latter may allow the exitus of cases with corrigible pathology.

The problem of lumbar puncture and its indications in the relatively pure forms of subarachnoid hemorrhage is beyond the scope of this presentation but is well discussed and described in many papers.

Petechial Hemorrhages

WE mention and discuss petechial hemorrhages only to round out and complete this thesis. How often they occur in those that survive is difficult to establish but about 34% of cases seen at the autopsy table show these small hemorrhages through the nervous system. The association of petechial hemorrhages with other forms of operative conditions makes for longer convalescence and less complete recovery with sequelae of a permanent nature.

Subdural Accumulation of Spinal Fluid

OUR discussion would not be complete without consideration of subdural accumulation of spinal fluid. This curious condition is seen in the more subacute forms of head injury. It is almost never diagnosed prior to operation. That there is a cause and relationship between this condition and clinical findings is proven by the rather remarkable results in some cases. It is a source of error if one is not careful. In the more doubtful cases, air studies should be performed to rule out a co-existent pathology. We have seen middle meningeal hemorrhage co-exist with this condition. In some cases this curious condition may be seen without traumatic basis.

The treatment is drainage of the subdural collection of spinal fluid through trephine openings.

Cardiovascular Disabilities

—of Railway Employees; Problems of the Consultant; a Review of Eight Years' Experience—

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Erie and Nickel Plate Railroads

EIGHT years' service as consulting cardiologist have given me an excellent opportunity to review cardiovascular disease as a cause of disability among railroad employees. The interest and cooperation of DR. JAMES DINNEN and of DR. J. FRANK DINNEN have aided me greatly in this report. Through their courtesies I have been able to follow the careers of many of the employees examined.

One hundred fifty-two cases, all employees of the Erie, Nickel Plate, Chesapeake & Ohio, and Pere Marquette form the basis of this study. These men were middle-aged, and were referred because of subjective or objective signs of cardiovascular disease.

The problems of the cardiac consultant of the railroad greatly resemble those of private practice and of industrial medicine. There are three important aspects of these problems:

1. The fitness of the individual to carry on his job with safety to himself.
2. The risk of individuals whose lives may be endangered by sudden disability or death of the employee.
3. The liability of the corporation or insurance company for responsibility in case of disability or death occurring during work.

These three aspects, with regard to the employee under consideration, must be borne in mind in rendering an opinion.

Heart disease today is the leading civil cause of death. What are the causes of these cardiac deaths? In a recent review of the cardiac deaths at the Cleveland City Hospital, based on a careful study of 790 necropsied cases, hypertensive heart disease led with 33.4%. Coronary artery disease was second, 22.4%. (This figure included cardiac failure resulting from severe widespread coronary artery sclerosis and from myocardial infarction.) Rheumatic heart disease was third, 16.1%. Syphilitic heart disease (aneurysm and aortic insufficiency) was fourth; cor pulmonale was fifth, 6.8%; and thyrotoxicosis was sixth, 1.1%. There was a scattering of other pathological findings in the remaining 11.5%.

In this railroad series the men were largely middle-aged (from 23 to 73 years) with an average age of 53.2 years. An analysis of the diagnoses revealed the following:

1. Hypertension, 59 cases (38.8%).

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2. Coronary artery disease, 36 cases (26.1%).
   Angina pectoris, 10 cases (7.8%).
   Coronary thrombosis, 26 cases (18.3%).
3. Rheumatic heart disease, 11 cases (7.7%).
4. Syphilitic heart disease, 4 cases (2.8%).
5. Cor pulmonale, 4 cases (2.8%).
6. Hypersensitive carotid sinus, 6 cases (4.2%).
7. Obesity, 4 cases (2.8%).
8. Hyperthyroidism, 2 cases (1.4%).

It is interesting to note that in the group where Wassermann tests were performed (84 cases) there were seven positive cases (8.3%), of which four cases had syphilitic heart disease. This figure of 8.3% may be compared with the incidence of syphilis in the new draft army 1.5 to 2%.

HABITS: The habits of the men were analyzed. Table I is a summary of the findings.

TABLE I.

		Coronary Artery Disease		Hypertension	
Alcohol	44% (134)	50%	(37)	34%	(56)
Tobacco	87% (114)	87%	(38)	82%	(55)
Coffee	93% (60)	90%	(19)	90%	(30)

In coronary artery disease and in hypertension there was no greater instance of the several habits than in the entire group.

HYPERTENSION: There were 59 cases of hypertension (38.8%). Of these 19 were engineers (32.2%). The engineers were 22.3% of the entire group. The average age of this group was 54.3 years.

In evaluating this group there are several criteria that were considered:

1. Symptoms referable to:
   (a) Cardiac reserve-exercise test.
   (b) Cerebral circulation. (c) Kidneys.
2. Association of symptoms of coronary artery disease.
3. Height of blood pressure, systolic and diastolic.
4. Size of the heart.
5. Condition of fundi.
6. Electrocardiogram.

If there is a fair-to-good cardiac reserve to exercise, if the blood pressure does not exceed 200 mm. of mercury, if the heart is not greatly enlarged, if the fundi show minimal changes, and if there are no symptoms of angina pectoris (coronary artery sclerosis) the chances are excellent that the man will be able to carry on his job. The question resolves itself into the function of the heart, the brain, and the kidneys.

Many of these men had no symptoms whatsoever. Some had signs of cardiac insufficiency, angina pectoris, and cerebral arterio-sclerosis. There was frequent association of hypertension with obesity and emphysema. While a blood pressure of 200 or over may carry a greater risk than lower pressure, this rule is not always accurate. The following cases illustrate the types:

CASE 1: Age 42. Conductor and brakeman. Was seen on September 4, 1934. At this time he was referred because of hypertension. His maximum pressure was 170/94. He had a good exercise tolerance. His heart was normal in size, and there was a faint systolic murmur at the apex. The electrocardiogram was normal. He has been able to continue with his work during the intervening seven years.

CASE 2: Age 61. Engineer. Was examined on July 26, 1937. His maximum pressure was 180/110. He had some indefinite anginal symptoms. The heart was normal in size, and the electrocardiogram was normal. He remained at his work until September 23, 1940, when he was disqualified. He is still living.

CASE 3: Age 58. Car inspector. Was seen on August 11, 1938. His blood pressure of 180/130 was discovered in a routine examination. Fluoroscopic examination revealed the heart and aorta to be definitely enlarged. He died February 11, 1939, while still an inspector and yard foreman.

CASE 4: Age 54. Engineer. Was examined on October 6, 1938. He had had high blood pressure for eight to 10 years, but had no complaint whatsover. His heart was not appreciably enlarged. He had a good exercise tolerance. The electrocardiogram was entirely normal. He has continued at his job without symptoms.

CASE 5: Age 43. Engineer. Was seen on May 14, 1935. His blood pressure was 204/110. He had had hypertension since 1932. His exercise test was good. The heart was not enlarged. He has continued at his job during the past six years.

CASE 6: Age 48. Engineer. Was examined on September 13, 1935. His blood pressure was 180/100. He had a good exercise test, and his heart was not appreciably enlarged. The electrocardiogram showed no significant abnormalities. He died three years later while still working as an engineer.

CASE 7: Age 58. Freight conductor. Was seen on June 10, 1936. His blood pressure was 168/110. He had frequent premature beats. There was no cardiac enlargement, and his exercise test was satisfactory. He died March 15, 1937, while working as a conductor.

These cases illustrate the difficulties in making prognosis. There is always the possibility of these patients becoming suddenly disabled because of cerebral accident or coronary thrombosis.

Fortunately these complications are more likely to occur while the patient is at rest.

CORONARY ARTERY DISEASE: This group comprises men with symptoms of angina pectoris and with coronary thrombosis. The ages ranged from 38 to 64 (average age 54.5).

The problems of men with coronary artery disease are difficult because of the uncertainty of the natural history of the disease. The average expectancy of life in both types of coronary disease is about four and a half years.

1. *Angina Pectoris*: This group was comprised of nine cases, ranging from 46 to 60 years of age, average 55.5 years. The outstanding symptom was angina of effort, and of emotion. The problems of differential diagnosis included syphilitic aortitis, arthritis, hypoglycemia, and gallbladder disease. The electrocardiogram was especially helpful, including exercise testing. This disease is especially hazardous for engineers and for men whose work is solitary, switchmen, signalmen, and telegraphers. If the pain is induced by

slight effort or emotion, there can be no question as to disqualification.

2. *Coronary Thrombosis*: This group included 23 men, whose ages ranged from 38 to 64 years, with an average of 53.5 years. Many men gave a typical history of an attack of coronary thrombosis. Some men followed the advice of their physicians and remained in bed from six to eight weeks, but there were many who disregarded advice and returned to work shortly after the symptoms subsided. The diagnosis frequently was made weeks or months after the attack—by the electrocardiogram.

Recent pathological studies by Mallory[1] and his associates have shown that the healing of the myocardium is completed in small infarcts in five weeks, and in eight weeks in the case of large infarctions. Rupture of the heart occurs most often in the first week, occasionally in the second week, and rarely thereafter. This knowledge of the life cycle of infarctions enables us to advise clearly the necessity of two to three months of physical and emotional rest. Following is a brief history of a man, illustrating an unusually long life span following coronary thrombosis.

CASE: H. R. Age 58. Air-brake repairman. Was examined on December 9, 1935, with angina of effort. His blood pressure was 170/98. His heart was moderately enlarged to the left, and the electrocardiogram showed evidence of a healed infarction. From his history this may have dated back eight years. He continued to work and died January 17, 1936, while still working.

The advice is clear. The first convalescence following infarction should be from three to six months, and only at the end of this period should an appraisal be made. If the man has a good exercise reserve and is free from pain on exertion he may be considered fit for work. The man should not return to work requiring hard physical labor. If the man is an engineer he should, of course, be limited to a yard engine. Disqualification should be advised in the presence of myocardial failure, or of angina of slight effort.

RHEUMATIC HEART DISEASE: There were 11 cases of rheumatic heart disease (7.7%). Following are brief case reports illustrating the various phases:

CASE 1: Age 41. Fireman. Was seen on September 16, 1938. He had no symptoms, but had definite signs of aortic stenosis. His exercise tolerance was good. It was definitely advised that he avoid strenuous physical activities. He has continued to carry on his job as fireman.

CASE 2: Age 57. Switchman. Was examined on January 13, 1936. A definite diagnosis of aortic stenosis was made. He continued to work until May 3, 1936, when he died.

I have advised that men with signs of cardiac insufficiency be disqualified. These men have a greatly reduced exercise tolerance and are unable, as a rule, to perform any useful work with comfort. There were three cases of auricular fibrillation, but without evidence of failure. These men were allowed to carry on their jobs.

SYPHILITIC HEART DISEASE was observed in four instances (2.8%). Syphilitic aortitis may be asymptomatic until aortic insufficiency develops, or an aneurysm occurs. Angina of effort may be a prominent symptom. With the onset of failure the prognosis is usually fatal within one year. Following are case histories illustrative of several phases:

CASE 1: Age 31. Fireman. Was seen on June 12, 1936. He had free aortic insufficiency, and a positive Wassermann. His blood pressure was 150/40, and the electrocardiogram was normal. He has continued to work as a fireman ever since.

CASE 2: Age 50. Air brake repairman. Was examined on May 25, 1936. He had luetic aortitis with aortic insufficiency. He had a large heart. His blood pressure was 220/60, and the Wassermann test was positive. He is still living, but was disqualified on February 10, 1940.

CASE 3: Age 40. Conductor. Was seen on August 1, 1934. There was evidence of free aortic insufficiency. His blood pressure was 150/40. Fluoroscopic examination revealed an enlarged heart and dilated aorta. He died on January 2, 1936, while still working as a conductor.

CASE 4: Age 57. Yard brakeman. Was examined on February 10, 1938. There were typical signs of aortic insufficiency. He died on October 11, 1938, while still working.

COR PULMONALE was diagnosed in four men (2.8%). It is usually associated with chronic pulmonary disease (emphysema and bronchitis). When failure is present (as evidenced by congestive failure) disqualification is definite. On the other hand mild dyspnea without signs of failure is not disqualifying.

HYPERSENSITIVE CAROTID SINUS was noted in six cases (4.2%). This condition results in syncopal attacks, which may endanger the life of the employee or people whose safety may depend on his conscious activity. Treatment may be advised, such as not wearing a tight collar, therapy with paradrene or denervation of the common carotid artery, and if the treatment is successful the man may carry on his job. Hypersensitive carotid sinus is found with greater frequency in arteriosclerosis and in coronary artery disease.

Hypersensitive carotid sinus may be a seriously disabling disease. It is evidenced chiefly by attacks of syncope, vertigo and convulsions.

If the attacks are frequent and severe they may not only be fatal to the man, but also to those whose lives may be endangered by his sudden disability. An excellent example is the following case:

CASE: J. S. W. Age 67. Conductor. Was examined on January 13, 1939. His chief complaint was that of vertigo and dyspnea on walking. He had had fainting attacks for four to five years. These came at intervals of several days. He never lost consciousness, and the attacks wore off in five to 10 minutes. His blood pressure was 166/128. His heart was not enlarged. There were no signs of failure. Following pressure over the right carotid sinus I was able to reproduce the attacks. I believed that he was unfit to carry on his work because of the frequent syncopal attacks.

1. G. K. MALLORY, P. D. WHITE, and J. SALCEDO-SALGAR: The Speed of Healing of Myocardial Infarction. A Study of the Pathologic Anatomy in Seventy-Two Cases. *Am. Heart J.*, 18, 647, 1939.

OBESITY: This is a frequent finding in railroad men, especially in engineers. It may be associated with coronary artery disease, or with heart failure. Advice is given as in other types of heart disease.

HYPERTHYROIDISM: Thyroid heart disease was noted in two cases (1.4%). This illness of course is incapacitating, but after proper therapy the man may be able to return to his job. If he is not properly treated or refuses to cooperate—disqualification is advised.

FOLLOW-UP OF CASES: Reports from 82 men were obtained recently, 12 of whom died, and 70 are living. These 12 men died the following periods after consultation: One month or less, three cases; two months, one case; four months, one case; six months, one case; seven months, one case; eight months, one case; nine months, one case; one to two years, two cases; three years, three cases.

In this group there was but one where no evidence of circulatory disease was found.

In summarizing the 152 examinations of this report the incidence of hypertension, coronary artery disease, and rheumatic heart disease is much the same as in a large series of necropsied cases. The ability of the men to carry on their job depends largely on the function of the heart, the brain, and the kidneys. In the absence of symptoms and a good exercise test, these men are frequently able to carry on their jobs. Frequent examinations, of course, are indicated in the presence of circulatory disease of any type.

In coronary disease, men who have angina of slight effort should be disqualified. Following attacks of coronary thrombosis, if there are no symptoms men may be allowed to carry on their jobs, providing they are not alone in their work. Engineers should be limited to yard runs. Fortunately in the railroads with which I am associated there have been no serious difficulties with men who have been allowed to continue their work.

This plan, with a humane feeling for the employees, and a sense of responsibility to the railroad and its passengers has resulted in a fortunate handling of men who are borderline disabled.

Inguinal Hernia

—*Newer Methods of Repair*—

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A PAPER contemplating a discussion of newer methods for repair of inguinal hernia should undoubtedly embrace a resumé of recent acknowledged methods of procedure; anatomic varieties of repair and the suture materials used; and end results as to recurrence and infection rate. This resumé should cover clinical reports during the last decade, which should give time for evaluation of results from large series of cases by operators and clinics which are constantly on the alert for those methods which result in the least morbidity to the patient.

Presented at the Fifty-Second Annual Meeting of the AMERICAN ASSOCIATION OF RAILWAY SURGEONS, Chicago, September 9, 1941.

Fascia Sutures

DR. ROBERT M. JOYCE, of Portland, Oregon, last year reported a splendid series of 760 operations, with 544 traced cases out of a total of 674 patients with a recurrence rate of only 2.94%. His operation consists of fascia-to-fascia suture under the cord from internal ring to pubic spine after high ligature and a transfixing of the sac. He cuts a fascia strip one-quarter inch wide and five inches long from the superior border of the external oblique muscle, the proximal end of which remains attached on the pubis. This strip is used for suturing the external oblique border to the inguinal ligament. If it runs out before reaching the internal ring, it is supplemented with chromic gut. The inferior border of the external oblique is sutured with another fascia strip after being brought up and over the cord. No mention of the rate of infection was noted in Dr. Joyce's cases, but it is presumed it was not a factor in morbidity.

Many excellent reports are made of the fascia suture method by others than Dr. Joyce, one being Dr. Wm. L. Estes, Jr., of Bethlehem, Pennsylvania, who (reporting in *Annals of Surgery*, May, 1941) gives a recurrence rate for indirect inguinal herniae of only 0.4%, and for the direct variety, 2.77%. There is a slight anatomical variation from Dr. Joyce's method of repair, but a fascia-to-fascia suture is the point stressed in his case results. A recurrence rate of 17.6% was given for recurrent herniae. His series embraced 416 herniae operations on 394 patients.

Silk Sutures

DR. ROLAND L. MAIER, of New York City, reporting on the use of silk suture material, recently presented a resumé of the results on the First Surgical Division of the Ruptured and Crippled Hospital, of New York, as follows:

Seven hundred and seventy-seven hernia operations performed by six visiting surgeons and 12 house surgeons; an infection rate of 3.8% in 1934 and 1935, which was improved to a rate of 0.65% in 1938. The recurrence rate in 71% of follow-ups was 6.3% for the primary indirect, and 12.7% for the primary direct types. Recurrence rate on recurrent herniae was 37.5%. These rates of recurrence are higher than those given in the two series of cases above mentioned using the fascia suture method. There is, however, a marked reduction in the rate of infection from silk over the rate previously experienced.

Many operators since Bassini, who first tried silk in 1889, have used it but have been forced to give it up on account of a high rate of infection, sinus formation, and subsequent hernia recurrence, although Dr. Halsted, of Baltimore, and his associates stayed with it.

Silk and Chromic Suture

DR. LONGACRE reported a series from the Presbyterian Hospital, New York City, comparing results with silk and chromic suture materials, giving a total of 5.5% recurrence for indirect hernia, 9.8% recurring with chromic catgut, and 2.16% with silk suture material. The rate in direct herniae is given by Dr. Longacre as 13.6% with chromic catgut, and 4.49% with silk. Total recurrence rate for direct hernia, 6.4%. The rate of infection was not stated.

Chrome Alloy Stainless Steel Wire

A MORE recent material for sutures has been added to the surgical armamentarium, consisting of different sizes of chrome alloy stainless steel wire. The use of this steel suture was first reported by Dr. W. Wayne Babcock, of Philadelphia, in 1934. At that time he reported its use for sutures but was hesitant to give conclusions on account of lack of time to observe results. He stated, however, that it was noteworthy for its marked tensile strength, stretching one-third of its length before breaking. It is extremely resistant to corrosion, as demonstrated by the fact that after being covered for three months in a plaster cast, steel sutures in the skin retain their brilliant luster and show no tendency to irritate the tissues. The same author enlarged upon his experiences and reported his findings (in *American Journal of Surgery*, January, 1935), at this time stating that he used it in infected wounds and found his results satisfactory. He stated that "from the catgut buried in wounds, tissue reaction occurs with leukocytosis, infiltration, weakening and local necrosis about the sutures. The reaction with liquefaction and removal of catgut precludes that of tissue union, and as a result healing is delayed or impaired." Further, Dr. Babcock states that this material has much greater resistance to corrosion or chemical change than silver wire. Where the steel wire suture has been used for ligatures and deep sutures in septic wounds the same author states "in reopening such wounds in stage operations, no fibrosis, local irritation, discoloration or pus formation has been observed from the wire." Dr. Babcock has used it in many fields, from fixation suture of fractured bones, to mucous membrane suture in cleft palate, and found it always free from the effects of tissue corrosion. The only particular caution is to prevent the kinking or twisting of the wire as it may cause it to break. It is tied in secure knots, as silk would be tied.

Dr. Sterling Bunnell, of San Francisco, has reported the use of this stainless steel wire for primary repair of severed tendons, with equally excellent results and freedom from tissue reaction, as was recorded by Dr. Babcock and other writers. One method of suturing reported by Dr. Bunnell permits the steel suture to go through the skin at a distance from the tendon suture line and remain out of the skin for a period of two or three weeks, subsequently using a protruding portion as a suture remover for the fixation steel tendon suture. Dr. Bunnell states that he is enthusiastic over its freedom from irritation in the skin where such irritation could be freely seen.

Dr. Thomas E. Jones, of Cleveland, has reported this year that they have been using alloy steel wire suture material with increasing frequency at the Cleveland Clinic for the closure of abdominal wounds, and that the incidence of abdominal wound morbidity has been reduced to such an extent as to warrant a report. Dr. Jones presents a detailed review of wound disruption in their Clinic for the decade 1930 to 1940. This is detailed as to number of such disruptions and as to location of the incisions. The incidence rate was 1.05%, and the mortality rate in these disruptions was 34%. Dr. Jones and his associates at first proceeded cautiously, doing only part wound closure with steel sutures, but as results grew better they came to all-steel suture closure. Buried interrupted figure-of-eight alloy steel sutures, after the method described by Smead, of Toledo, were used to close 81 upper abdominal wounds particularly prone to disruption. One disruption occurred in this series and in view of the fact that nearly all the severe cases with jaundice and malignancy were in this group, significance of the good result is the more apparent.

As to wound infection, Dr. Jones reviews his cases of wound healing in combined abdominoperineal resections for carcinoma of the rectum. In a series of 76 such operations, closing the abdominal wound with catgut in layers and silkworm gut for stay sutures, the incidence of infection was 27.5%. In 64 cases the peritoneum and posterior rectus fascia were closed with catgut and the anterior rectus sheath with interrupted alloy steel sutures. Stay sutures were not used. The infection rate was 14%. In 116 consecutive cases the abdomen was closed with steel figure-of-eight sutures alone, including all layers except the skin and subcutaneous tissues. No stay sutures were used. The skin was closed with clips. Infection rate was 0.85%. The wound disruption rate was zero. Dr. Jones states that the disadvantages of steel wire are few. Rarely a suture will perpetuate a draining sinus. It has been necessary to remove sutures for this reason in only two instances. Occasionally a patient with scanty subcutaneous tissue will complain of discomfort about the knot, but it is a simple procedure to remove the suture under local anesthesia.

In a personal communication to the author last June, Dr. John Garlock, of New York City, stated that two years ago they started using No. 30 steel wire routinely for closure of abdominal walls, at Mount Sinai Hospital—that this step was brought about by the high incidence of wound disruption. Since the use of this method of closure there has not been one case of wound disruption. No catgut or retention sutures are used, and the skin and subcutaneous tissue are closed with clips.

Dr. J. Matthews Farris, of the Department of Surgery of the University of Michigan, reporting his experiences on tissue reaction to various suture materials (in *Annals of Surgery*, July, 1941),

states that he placed some common suture materials in the anterior chamber of a rabbit's eye, which is an excellent culture medium. Using silk, he found no reaction in seven days; at 14 days there were 250 leukocytes per cubic millimeter. With spool cotton, these cell counts were slightly less. With stainless steel wire, the reaction could scarcely be measured, and cell counts averaged only five to 10 leukocytes per cubic millimeter. In all instances, with these three materials, there was no harm to the eye whatever after a year's time. With catgut, however, the aqueous humor was apaque in 10 days and the eye became blind. The appearance of the chamber was that of being filled with pus and the reaction amounted to from 2000 to 6000 cells per cubic millimeter, but cultures were always negative. Reaction to plain catgut was estimated to be twice as great as to chromic catgut.

Report of Cases

IN presenting this paper, nothing original is claimed in the way of anatomic repair or for the non-absorbable steel suture material used. A very small number of cases is presented, namely, 17 patients personally operated in the past year, with a total of 24 herniotomies. Approximately a like number have been operated upon in the same way by members of our staff in Salt Lake City. The limitations of such a small series in evaluating final conclusions are fully recognized, and the values of our results must be adjudged as time permits.

Temporarily at least, several advantages have been gained for the patient, in the use of chrome alloy stainless steel wire, as used in these cases. There is less hospitalization than formerly required. Also the total time interval before return to work has been cut to half, as against that previously required. These two factors are the principal consideration for presenting this paper. They have direct bearing on economic saving to all concerned, namely, to the patient, to the employer, and to the insurance carrier.

Formerly, silk suture material was tried by us but was given up on account of the high rate of infection and sinus formation which these sutures produced in our hands. Secondly, with the use of catgut we felt obliged to keep the patient in bed in the hospital for three to four weeks to insure adequate healing to make us feel safe in allowing the patient to leave the hospital. Another three to four weeks were allowed for recovery before permitting return to work. Since August, 1940, with the use of stainless steel wire material, we have felt justified in shortening the convalescence period both as to hospitalization and total elapsed morbidity as above cited.

Surgical Procedure

WITH the use of stainless steel wire suture material, the operation now performed consists of sewing the flat muscles of the transversalis and internal oblique and conjoined tendon to the inguinal or Poupart's ligament with interrupted steel sutures No. 30 size. This is done after removal of the sac with high ligature, returning the stump to the abdominal cavity. Large bites are used in the flat muscles and tendon, with care in taking these large bites to avoid the iliohypogastric nerve. The tissues sutured with the interrupted steel wire underlie the cord from the internal ring to the spine of the pubis, and care is exercised to make the approximation to the inguinal ligament snug but without cutting tension. A careful attempt is made both in direct and indirect varieties to effectively close the area above the pubis by sewing the thick ligamentus fascia on its anterior surface to fibers of conjoined tendon or rectus sheath above. Thus a typical Bassini operation is used with cord transplant, and steel wire non-absorbable suture fixes the floor under the cord. Chromic "O" catgut continuous suture was used in most cases to date to approximate the edges of the external oblique fascia over the cord.

Review of Cases

THE ages of the 17 patients operated upon were between 23 and 65 years, and the average hospital days were 10⅓ per patient. In each instance the patient entered the hospital the day before operation. There were two cases of mild infection. In one instance, in a patient 49 years old who left the hospital in eight days, there was a mild infection consisting of serous drainage from the center of the wound and he was dressed in the office daily for 10 days before the wound healed permanently. During this healing time he was not confined to bed. His total absence from work amounted to 30 days. This patient had previously had the injection treatment.

Another infection occurred in a station baggageman, 51 years of age, who entered the hospital with a strangulated left inguinal hernia. This was reduced and he was operated upon the next day. His total was 10 hospital days, and he resumed work 30 days after operation, doing regular station baggage work which is exceedingly arduous. His wound drained a serous discharge for five days.

Mild infection in these two cases did not interfere with quick and complete wound healing nor contribute additional lost working time.

Of the 17 patients, upon whom 24 hernia operations were performed, four had multiple operations other than hernia repair, these consisting of circumcision, tonsillectomy, appendectomy, and varicocele.

One patient, of age 49, a section laborer on the railroad, operated upon for bilateral inguinal hernia, with steel wire both for closure of the floor and also closure of external oblique fascia, developed a right-sided orchitis on the fifth postoperative day. His temperature went to 100.5°, which was the highest temperature elevation recorded, and the next day it was 99°; on the third day it was normal. This was a mild inflammation, and we think it may not have resulted in loss of the testicle, although he has not been subsequently

followed, since his residence is in another state.

The average time lost before returning to work in this series was 29 days.

Summary

IN summary of this brief series of 17 patients having had 24 hernia operations, four of them having other operative procedures, there are two cases of infection of a mild nature, healing promptly without sinus formation, and one case of orchitis, which subsided by the third day. The average hospital stay was 10⅓ days, and the average elapsed period before return to work was 29 days, this being a considerable improvement over our previous record in elapsed time before returning to work. The nature of the work in those operated upon ranged from railroad section laborers to baggagemen, to service station operators, executives, taxi drivers, and linemen for a utility company. There have been no recurrences to date, although again it is mentioned that we attribute little value to this, owing to the short period of time since our adoption of steel wire non-absorbable suture material in doing these repairs.

Conclusions

WITH the use of chrome alloy steel wire non-absorbable material, hospitalization and lapsed time of days lost from work have been effectively reduced.

Owing to the use of non-absorbable suture which is resistant to tissue reaction, no hesitancy is necessary about permitting early return to work.

The patient experiences no ill-effects from the presence of the wire.

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AMERICAN MEDICAL DIRECTORY, Seventeenth Edition, 1942, lists 29 Specialties. The 29th, and latest, included this year for the first time, is "**Ind**—Industrial Practice." The Directory identifies 200,000 physicians, 7400 hospitals, covers the United States, Canada, Alaska, Canal Zone, Hawaii, Philippines, Puerto Rico, etc. It may be ordered from American Medical Association, 535 North Dearborn Street, Chicago.

Skin Diseases

—Common to Railroad Employees—

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ON casual regard, one would think there should be some skin diseases more common to railroad employees than are seen in the general run of skin cases. However, in checking our records it was found that this is not true. Creosote dermatitis, which was so frequently seen 15 to 20 years ago, has become a rarity. This is due to newer methods of impregnating the ties with the creosote that leaves little excess to come in contact with the handlers. Also in our experience there are very few dermatoses among the painters or brass workers. However, the records did show that fungus infection was the most common disorder that brought the patient to the skin department of the Santa Fe Hospital in Topeka. This is also true of the general office practice; it is estimated that at least 75% of men throughout the south and southwest part of our country have a fungus infection of some degree of severity, mostly a dermaphytosis of the feet.

You are all familiar with this condition, which ranges in the acute stage from a few vesicles between the toes or elsewhere on one or both feet to an extensive involvement of both feet by an oozing dermatitis with, at times, an allergic involvement of the hands manifested by marked vesiculation and edema. Quite often the entire condition is complicated by a secondary bacterial infection that adds pain to the discomfort of the swollen parts. The chronic stage is the dry scaling type, the lesions of which tend to have a circinate configuration.

The different stages, of course, demand certain treatment. One should never use a strong salicylic preparation on an acutely inflamed fungus infection, but rather soothing astringent solutions. For this I would recommend A1 acetate, drams 1, boric and tannic acid, of each ounces 4. One teaspoonful is dissolved in a quart of cold sterile water. This solution is applied to the feet by wet packs. For some reason the gauze and solution in close contact with the affected parts gives better results than simply soaking the feet in the solution in a foot tub. Along with these soaks in the acute stage I feel that we get some improvement by intravenous injections of sodium thiosulphate. This is given twice weekly in 15-gr. dose. If a bacterial infection is superimposed, an aqueous solution of gentian violet, 2%, is applied to the infected areas after opening the pustules, and sulfathiazole, gr. 7.7, is given by mouth. Potassium permanganate soaks are also useful with this infected condition. I do not believe that the x-ray has any place in the treatment of the acute stage.

Most of the cases, however, are of the chronic type and usually respond to persistent use of a

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salicylic ointment of which none is better than Whitfield's or its modification as fits the type of skin you are dealing with. The patient is instructed to continue the use of the ointment after all traces of the infection are gone in hope that continued exfoliation may rid the skin of the spores that will lie dormant for years. I feel that most of the recurrences are due to new growth of the fungus from the spores rather than a reinfection. Usually the recurrence is exactly the spot that was involved at the time of the preceding outbreak.

The question of sterilization of the shoes always comes up. This can be done by wetting pieces of blotting paper with formaldehyde, placing one in each shoe, wrapping securely with paper, and letting stand for 48 hours. The shoes then should be aired for several days before wearing to get rid of the formaldehyde.

X-ray therapy does attenuate the organism in the chronic stage, but the continued use is not advisable since it will not produce a cure and there is always danger of an accumulation affecting the skin when used with each recurrence.

The second most common affection encountered involved pre-malignant and malignant conditions about the face. It seems the railroads have employed more than their share of the ruddy-faced Scotch and Irish. There is no question but that the sun and wind of the summer, and the cracking in winter from the cold are irritating factors with these tender skins. Seborrheic keratosis is most often the lesion for which the patient comes in for treatment. This comprises the changes in the skin manifested by small areas of thickened skin about the nose, cheeks and lips that peel off and recur, persisting for months or years, and many finally changing into a malignancy. If seen early, these keratoses can often be removed by daily application of Fowler's solution. This causes an irritation and subsequent exfoliation. The more advanced demand radiation or surgical intervention. Malignancies, of course, are handled as thought best by radiation or surgery or a combination of both. The Mexican employee rarely has a seborrheic keratosis and only a few skin malignancies. The negro seldom has a skin malignancy.

The next most frequent dermatoses encountered are that large group of dermatitis venenata of which poison ivy is the most common offender. Little difficulty is experienced in diagnosing poison ivy irritation. It usually comes in streaks and nearly always one finds patches on the face from contact with the hands. Wet packs are still the best method for the most comfort in this condition. The Al acetate, boric and tannic acid mixture or sat. of Al acetate may be used. Of the injections used, I prefer the water soluble type. Frequently considerable relief is given in the first 24 hours and a second injection often cuts down the disability considerably. Many of the weed contacts, however, present a much more difficult problem to determine the causative plant. The dermatitis, of course, usually appears on the exposed parts, i.e., arms, face, and legs to the knees, persisting for many years during the growing period of the plant. Shelmire has recently shown how patch testing may be done rather simply with the oleoresins of the weeds commonly encountered, and how by oral administration with a dilution of the offending oleoresin the patient may be desensitized or becomes less sensitive. This contribution is being thoroughly investigated and may be of considerable help in taking care of the employees we see returning each summer for hospitalization because of these weed contacts.

Next in order were the bacterial dermatoses. Of these impetigo contagiosa was the most frequent and, of course, most often seen in the height of hot seasons. Impetigo contagiosa may be due to either staphylococcus or streptococcus. The staphylococcus invasion usually is the rather large vesicular type with the spreading edge and the depressed center, and the streptococcus is marked by the accumulation of a piled up crust and not so much tendency for the single lesions to enlarge. Since the advent of the sulfa group there is little use for ammoniated mercury in the treatment of impetigo. It is used in the early stages when there is considerable oozing as a 5% solution of sulfathiazole in calamine lotion, and as the lesions become dry in later stages in a 10% ointment. A bichloride solution 1:2000 may be used to remove the crusts during the acute stage. Forceful removal of the crusts by soap and water is not desirable.

Not infrequently following an impetiginous infection, we have ulcers appearing on the legs. This condition is called ecthyma, commonly "dew sores," and is characterized by indolent ulcers usually on the legs, having an infiltrated border and a thick, oozing scab in the center. Thanks to the sulfa group again we are now able to clear them rather promptly by sulfathiazole by mouth, 7.7 grs. four times daily and 10% sulfathiazole ointment. The lesions should not be disturbed every day but let alone for two or three days.

Sycosis of the beard is also a bacterial infection, and because of the hundreds of ports of entry and the necessity for the patient to shave daily, it is difficult to control. In my hands the sulfa group has been rather disappointing in the treatment of sycosis. I prefer relying on x-ray therapy, 1:2000 sol. of bichloride packs, and 1% resorcin in alcohol for local application. I have had no success with chlor. hydroxy quinolin ointment.

Pruritus ani is quite frequent, and a source of considerable aggravation to the desk workers. This condition is often a fungus infection and improves with applications of a mild salicylic ointment. It is very essential to treat any co-existing dermaphytosis of the feet which is usually present. Other cases may be of local pathology, such as fissures and hemorrhoids, and do not forget that adults may have pinworms. The cases for which a definite cause cannot be found except for a change in the skin as we see in neurodermatitis are relieved by x-ray therapy.

(Upper left): In the Clinical Section and Reception Room. (Center left): Dr. Harvey Johnston and Technician Marjorie Lasker review a test in the Laboratory. (Lower left): Dr. Thomas C. Douglass, Medical Director, discusses the new X-Ray Unit with Colonel Charles G. Hutter, of the Surgeon-General's office. (Upper right): In the Surgical Section Nurse Mildred Kruse, Dr. John E. Karabin, and G. W. Adrianson, Manager of Industrial Relations. (Lower right): Technician Marjorie Lasker and Nurse Mildred Kruse, at the x-raying of a broken arm.

Commonwealth Edison's Medical Offices

RIVALING the most up-to-date hospitals in attractiveness and completeness of facilities, the recently modernized medical offices of the Commonwealth Edison Company in Chicago rank among the nation's outstanding examples of industrial medical progress. Close attention has been given to every detail of design and equipment in this streamlined "health center" with the view of contributing to the comfort, convenience and privacy of the employee patients.

The offices are executed in pastel green, which is pleasing and restful to the eye and also serves to increase the efficiency of the high-intensity indirect lighting. Floors are of green asphalt tile and ceilings acoustically treated to minimize noise. Such traditional dust catchers as moldings, window linings and casings have been eliminated in the interest of cleanliness, and all-steel office furniture of advanced design harmonizes with the streamlined appearance of the walls and partitions. Admittance, consultation and treatment rooms are arranged in a sequence which expedites service to patients and reduces waste motion.

The effectiveness of the company's medical ser-

vice to its employees has been increased substantially by the inclusion of an x-ray machine of the most modern type and a fully equipped laboratory in which all standard tests can be run. The new x-ray unit is used chiefly for pre-employment examinations and accident cases.

Stainless steel cabinets and equipment are used exclusively in the laboratory as well as in the surgery room. A specially designed fluorescent ceiling unit in the latter location provides cool, high-intensity, shadow-free light on the operating table.

Services of the Edison Company's medical division are not intended to supplant those of private practice. Treatment is given only in accident and emergency cases and for minor illnesses which do not seem to require the care of an outside physician. The staff is always available to employees, however, for consultation and advice and makes periodic examinations of the entire personnel as a means of discovering physical defects before they become serious.

The staff of DR. THOMAS C. DOUGLASS, Medical Director, comprises four assistants at the main medical offices in the company's downtown office building and another doctor at each of its two service buildings. There are also five registered nurses, a laboratory technician and four clerical employees.

Medicolegal Aspects

—*of Traumatic Injuries and Spontaneous Rupture of the Heart and Aorta*—

SAMUEL A. LEVINSON, M.D.,
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IF a disease is the result of trauma, say Brahdy and Kahn[1] "there usually is found a continuity of symptoms from the time of the occurrence of the injury to the time of the appearance of the disease it has caused." Now this simply means that from the pathological anatomical point of view we are confronted with the problem if the trauma is the direct cause of the disease which ultimately led to death, or whether the trauma is a secondary factor and has no direct relationship with the pathology causing death. This question can be settled with the least amount of difficulty as far as the clinician and pathologist is concerned. However, we are frequently called upon by the legal profession to state with certainty and beyond any question of doubt that there is a direct connection between trauma and disease, or death. Furthermore, this gap between the findings of the pathologist and the application of these findings by the legal profession, can be further reduced, if the members of both of these professions would have a better understanding as to the interpretation of the causal connections of these two conditions.

Frequently the members of the legal profession will insist upon asking the doctor if the supposed trauma may have aggravated or precipitated a pre-existing pathological entity, this in turn resulting in the death of the individual. It is possible that such a role may take place. It assumes that the individual did have a pre-existing pathological alteration in one or more of his organs which might have in the course of time resulted in the death of this person. How long a time an individual might live with certain pathological conditions in his organs is purely conjectural. Therefore, if it is assumed that a person has a bullous emphysema of his lungs, and he is called upon to move a heavy object and by so doing ruptures the blebs on his lungs and dies shortly thereafter, might we interpret this phenomenon as meaning that the effort of pushing a heavy object resulted in increased intrathoracic and interpulmonary pressure, with a resultant rupture of the bullae. Can one, therefore, say that this episode is accidental, and allow the relatives of the deceased to claim compensation; and by so doing expose the pathologist to the definite question, namely, is death resulting from this ruptured bullous emphysema due to an accident?

In order further to clarify the position of the pathologist in relation to the question of trauma, and death resulting therefrom, we can cite a few examples from our own experience which concerned itself with the pathology of heart disease.

Point—Counterpoint

AN adult white male, 33 years of age, was employed by the City of Chicago as a refuse collector and was found one day by his fellow-worker sitting on the stairs with an empty garbage can alongside him. He complained of severe pain in the chest, and a few moments later went into a state of collapse and shock, and died before he could be taken to the hospital. The man was married, and his wife said that her husband always was well, was never sick, never complained of pain, and worked every day of the week, Furthermore, he had life insurance policies and health and accident insurance policies. She was beside herself in explaining the sudden exitus of her husband; in fact some element of suspicion was raised because she could not believe that her husband could have died suddenly of natural causes. An autopsy examination was performed, and the examination of the head, lungs, and abdominal viscera revealed no gross pathological changes. There was no evidence of fracture of the long bones or ribs. Toxicological examination of the organs was negative. The essential pathology was an accumulation of blood in the pericardial sac resulting in a tamponading of the heart. It was further noticed that there was a laceration in the apical portion of the left ventricle. The heart was tremendously enlarged, weighing 655 grams, and there was a marked thinning out of the apex of the left ventricle with an aneurysmal formation in the region of the recent rupture of the heart muscle. There was further evidence of fibrosis of the myocardium, particu-

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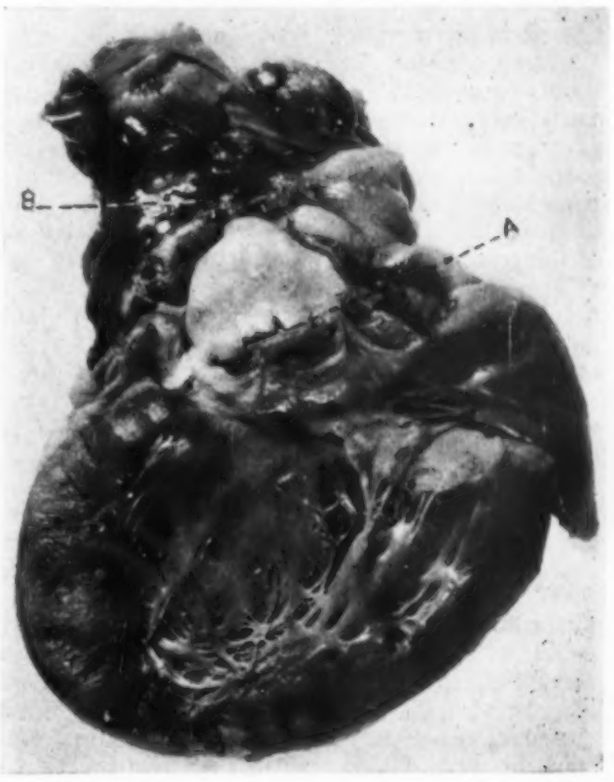
larly in the aneurysmal portion of the left ventricle. There was an old fibrous thickening of the mitral valves with a shortening of the chordae tendinae, and fibrosis at the insertion of the chordae tendinae into the papillary muscle. The right heart also showed evidence of hypertrophy. The auricles were dilated, the right more than the left, and the pulmonary artery and its valves showed no gross changes. The aorta and aortic valves were uninvolved, but there was evidence of atherosclerotic deposits with occlusion of the terminal vessels in the left descending coronary artery. This patient obviously had a "cor bovinum" with an old atheroselerosis of the coronaries, with subsequent myomalacia of the heart muscle with a resultant fibrosis, dilatation and aneurysmal formation. The rupture of the aneurysm in the left ventricle of the heart resulted in a hemopericardium and sudden death. The widow and her attorney were quite insistent that the death of this individual was the result of an accident. Had not this man been employed in carrying the heavy garbage cans up and down several flights of stairs he probably would have been alive. At all events the nature of his work had precipitated this cardiac pathology (ruptured cardiac aneurysm) resulting in death.

As a counterpoint to the above example, we can cite the case of a man about 40 years old who was found dead in bed. The history was that he was a salesman by profession, never sick, was never attended by a physician, and that he was in perfect health. A similar finding to the one described above from a pathological standpoint was noticed on the autopsy table, the difference being that the salesman did not have as large a heart as the garbage worker, but the pathology was the same. This salesman also had a ruptured left ventricular aneurysm with hemopericardium. This, therefore, was a natural cause of death; whereas in the case of the garbage worker, who had a similar type of pathology but with no evidence of external trauma, we are asked to interpret this as being on an accidental basis.

We can cite another point-counterpoint in reference to the disease of the large blood vessels of the heart, namely the aorta. Traumatic lesions of the aorta are not common but when they do occur are usually fatal. For example bullet wounds, stab wounds, penetrating lacerations due to fractured ribs, and severe trauma to the anterior chest wall are some of the traumatic causes for rupture of the aorta with hemorrhage into the surrounding tissues, and at times into the pericardial sac with almost immediate death.

I would like to mention an example of traumatic rupture of the aorta that occurred in an aviator. This pilot was a 28 year old white man who was alone in his airplane. For some unknown reason the airplane suddenly fell on the ground in the vicinity of the landing field. The airplane was smashed to bits. I do not have the information exactly from what height in the air the plane suddenly came to the ground. When the pilot was removed from the airplane it was noted that his clothes were covered with blood. He had contusions and abrasions on the anterior chest wall with multiple fractures of the ribs anteriorly, particularly along the insertion into the sternum. On autopsy, when the chest and viscera were examined, a horizontal laceration in the aorta 2.5 cm. in length was found above the valves. Obviously this laceration was the result of the trauma to the chest wall, and there is therefore a causal connection between trauma and death. On further examination of the heart no histopathological manifestations of disease were noted.

Now as a counterpoint to the case just cited, we had occasion to perform an autopsy on a 53 year old white male who had the following history: He had parked his automobile at a gas station to buy some gas. For some unknown reason he was unable to start his car again and he decided to crank the motor. When he attempted to do so, he suddenly experienced a sharp pain in the chest and called to the gas station attendant for aid. Shortly thereafter the man died. The relatives of the deceased were in the automobile at the time and they, as well as the gas station attendant, gave testimony that the deceased had not injured himself when he attempted to crank his automobile. On autopsy we found a horizontal laceration on the posterior wall of the ascending aorta immediately above the aortic valves. The illustration (below) shows this laceration, and hemorrhage into the pericardial sac. It will also be noted that the heart muscle was thickened, and



Spontaneous rupture of the aorta above the valves in a 53 year old white male:

A. Laceration.

B. Hemorrhage into pericardial sac.

the left ventricle dilated. There was an eccentric hypertrophy of the left ventricle. The chordae tendinae were shortened and thickened, and one can also notice an ancient fibrous thickening of the mitral valves. Examination of the coronary vessels showed an atherosclerosis but no occlusion of the vessel. Examination of the lungs was essentially negative, and the abdominal organs revealed no unusual pathological changes. The brain was grossly negative. Histological examination of the aorta showed a marked atherosclerotic deposit. The relatives, with the aid of their attorney, were insistent that there was connection between the effort of cranking the automobile and death; in other words that the rupture of the aorta in this 53 years old white man was accidental.

ONE can recite numerous examples where the pathology is more or less the same whether it is preceded by trauma, or if injury is an incidental factor, or where injury might be entirely absent. It is not unusual in the experience of the pathologist, particularly one doing medicolegal work, to find hemorrhage in the lungs preceded by a blow or trauma to the chest wall without any evidence of fracture. We have on several occasions found blood in the abdomen with laceration of the spleen without any evidence of external violence (as in malaria). Numerous examples of this kind have been observed in the organs of the abdomen and the chest, as well as the brain. Therefore, the question is, where is the pathologist to draw the line; whether disease found in the dead body, or death resulting from diseased organs is directly due to trauma, or if it is definitely spontaneous in origin. Then again if it is spontaneous, is this the result of some effort, such as lifting? Or could some other factor such as a psychic disturbance precipitate a pre-existing pathological condition and lead to death? If a person sustains a bruise to his leg and some days to weeks later is found dead because of sclerosis of the coronary arteries or sub-dural hemorrhage of the brain, can we justify a causal connection between trauma in one part of the body and pathology causing death in another? We are cognizant of the fact that exceptions to the examples just mentioned may happen, such as an embolus or a thrombus. Also, that injury to an extremity may be followed by infection causing pathology in the internal viscera.

Occasionally when death is due to spontaneous hemorrhage in the lateral ventricles of the brain, there is a history of a preceding injury. It is told that the deceased some time previously was pushed and received a "bump," although no evidence of trauma could be found on autopsy. Nevertheless, for the sake of the "double indemnity policy" such a history is given. Then the question is asked, had not this shock or fright that the individual sustained been responsible for the brain hemorrhage which resulted in death? We as pathologists have difficulty in answering this question for the reason that we cannot demonstrate a sequence of pathological changes from the beginning of the supposed trauma, and the pathology causing death. On the contrary, lawyers are most insistent upon wanting to establish such a connection. Frequently the doctor is asked could or might this so-called trauma, or injury, or fright, or shock have precipitated pathology far removed from the supposed primary origin of this condition resulting in death? And how easily the legal profession is satisfied by the answer "it might, or it could have."

In 1939, there were 3,438 investigations made by the coroner's office in which trauma was given as a responsible cause of death. There were 121 industrial accidents, 1,095 transportation accidents 277 homicides, 571 suicides, and 1,374 listed as general which includes falls, injury during play such as baseball, etc. Of this number (1,374) 130 cases were definitely proved by autopsy to be due to natural causes. In 81 cases, no causal connection could be correlated between the supposed injury and death. One can speculate that there are many more cases of supposed trauma, in which death was due to natural causes.

We can summarize our opinion with the remarks of White and Glendy[2] which appeared in Brahdy and Kahn's book on "Trauma and Disease." These authors state that "Trauma which affects the heart may be direct or indirect, and of various sorts and degrees. (1) The most obvious is the penetrating wound. (2) Definite, but less obvious, is contusion by a blow on the chest, or a crushing injury; this type includes direct injury from a fall against either a hard object, the ground, or the surface of water. (3) Less obvious still is the effect of indirect jarring, of a strain from a fall or of a sudden effort, as, for example, the effort exerted to lift a heavy weight or to prevent slipping. (4) Still more obscure are injuries to the heart from roentgen-ray exposure, from various poisons and gases (CO and H_2S), and from electric currents; lasting injuries to the heart from these sources have not been proved in man, and whatever damage results is probably only temporary, disappearing with the patient's rapid or gradual recovery from the immediate effects of the trauma. In fatal cases of this sort, some changes in the heart have been reported, as for example, subendocardial hemorrhage after CO poisoning, but such changes have been neither extensive nor consistent; chronic symptoms and signs, such as inverted T-waves of the electrocardiogram, resembling 'coronary T-waves', should be ascribed to pre-existing heart disease, whether or not accentuated or revealed after the trauma—as in the case of CO poisoning, about which, especially, there has been much uncertainty. (5) Finally, most problematical of all are disorders arising from nervous strain, fatigue, and excitement. That all these influences can cause heart lesions or disorders may be admitted, but when and to what degree they do so remain problems to be answered in each individual case. The answer may be clear and certain; often, it is bound to be vague and ambiguous, and sometimes no answer is possible at all."

1. BRAHDY, L., and KAHN, S.: Trauma and Disease, Lea and Febiger, 1937.
2. WHITE, P. D., and GLENDY, R. E.: Trauma and Heart Disease, in Brahdy and Kahn's, Trauma and Disease, p. 24.

Modern Burn Treatment

—With Special Reference to a New Dressing, "Foille"—

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THE treatment of cutaneous burns falls naturally into two distinct though related problems, the one the local lesion itself, the other the general or systemic disturbance resulting from the local lesion.

General Treatment

OUT of much conflicting clinical and experimental evidence, three systemic changes have emerged as the main targets for general treatment. The most important of these is hemoconcentration. Due to capillary stasis and increased permeability within the burned area, whole blood plasma is lost from the vascular bed.[1, 2, 3] Underhill and co-workers[4] estimated that in a burn of one-sixth of the body surface 70% of the entire blood volume would be lost in this manner within 24 hours. This loss of plasma with the resulting decline in blood pressure constitutes the syndrome of "burn shock." Impending shock can be predicted long before the actual vascular collapse by plasma volume determinations and, for all practical purposes, by the rising red cell count, hematocrit or hemoglobin value. The ideal prophylaxis, then, against shock in extensive burns is the replacement of the ebbing circulatory volume by plasma or serum transfusion.[2, 5, 6] Elkinton and co-workers[6] have devised a simple formula for calculating the volume of plasma required in any given case. It is important to remember that this plasma replenishment must continue throughout the period of increased capillary permeability which may last 48 hours or longer.

Despite the fact that whole blood transfusion adds to an already excessive number of red corpuscles within the burned patient, it is the best substitute when plasma is not available. Excess of water by mouth or of normal saline parenterally beyond normal hydration requirement is to be avoided[5, 7, 8] since, due to the already low plasma protein and osmotic pressure within the vascular bed, it is not retained but filters out and even tends to "wash out" some of the already reduced protein. If physiological saline is the only available fluid, it should certainly be given, but excessive amounts should be avoided and where possible, determinations of blood chlorides as well as of plasma protein should be made from time to time.

Read before Southern Medical Association, Louisville, Kentucky, November 12-15, 1940.

The second important change accompanying severe burns, as pointed out by Bardeen in 1898[9] and more recently by Wilson and co-workers[10] and McClure,[11] is hepatitis or, more exactly, a central necrosis of the liver lobules. In a fairly large series of fatal burn cases, dying within the first three days with toxemia-like symptoms not explained either on a shock or septic basis, Wilson found a characteristic hepatitis at autopsy. Also, Wolff and co-workers,[12] in three severely burned patients found depressed liver function by several different tests. Although the cause of the liver damage is still uncertain, treatment of severe burns should include therapy directed at the hepatitis. This would consist of high carbohydrate intake and, in addition as recently suggested by Ravdin,[13] of high protein intake. In patients too ill to drink, the Levine tube or parenteral route may be employed.

A third disturbance in the critically burned is an increase in plasma potassium, as pointed out by Scudder[14] and others, and thought to be due partly to adrenal damage from the burns, partly to cellular damage in the burned area. Weiskotten[15] in 1917 observed adrenal hemorrhages in fatal burns similar to those produced by diphtheria toxin. The adrenal cortical hormone maintains a normal equilibrium between plasma sodium and potassium, as well as normal hydration of the blood. In adrenal cortical insufficiency plasma potassium mounts, and there is loss of sodium and water through the kidneys. Doubtless on this rationale Scudder advocates in severe burns, hypertonic saline and cortical extract.

Rhoads and collaborators[16] believe that the synthetic adrenal cortical extract, desoxycorticosterone acetate, reduces the abnormal capillary permeability within the burned area and shortens the period of increased permeability and exudation.

Wilson and co-workers[17] reported three moribund burned patients saved apparently by desoxycorticosterone acetate. We have commenced to use the synthetic extract in the more severe burns but it is as yet too early to express an opinion.

Local Treatment

GENERAL CONSIDERATIONS: Although the chief interest in burns has lately turned to their biochemical changes, local treatment should not be underestimated since by it the long exhausting period of sepsis is combatted and disfiguring and crippling contracture is minimized.

In this clinic we recognize three grades of burn severity. First degree or erythema, as in sunburn, is really not a surgical problem. Second degree is characterized by blister formation and partial, but not complete, destruction of the skin. For the sake of greater accuracy in this controlled study of local applications, distinction is made between light second-degree burns in which vesiculation does not occur immediately and in which necrosis goes no deeper than the germinal layer of epithelium, and heavy second degree, in which barely enough corium, with its epithelial glands and follicles persists for skin regeneration.

Obviously, the former will heal the more rapidly, whatever the local dressing. Third-degree is full thickness destruction of skin and with it all potentiality of normal skin regeneration. This deepest burn is sometimes mistaken by the inexperienced observer as first-degree or merely slightly discolored skin, since there is often no blister formation. It is distinguished, however, by its coagulated, opaque appearance; also, it is dense and leathery to palpation and is relatively insensitive. Fig. 7 illustrates our burn chart and schema for recording area and depth of burn.

Deep second- and especially third-degree burns pass through two distinct phases which we shall term the "sloughing" and the "epithelializing." The former involves the separation of the necrotic burned layer from the underlying tissue. In full thickness loss of corium, as occurs in third-degree burns, there is usually a considerable septic reaction during this period; more so, certainly, than in second-degree lesions where a remnant of corium persists as protection to the subcutaneous tissue. Not until sloughing is complete, leaving a "surgically clean" raw area, will healing by epithelialization begin.

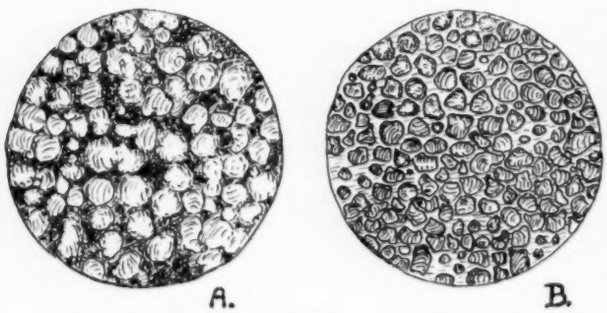


Fig. 1.
Semi-diagrammatic sketch of burns at end of sloughing and beginning of epithelializing stage.
A. Third-degree burn; granulation tissue.
B. Deep second-degree burn. Note the fine meshwork of regenerating epithelium among the granulations.

At this stage, even the deepest second-degree wound may be distinguished from the third-degree, since the latter is simply granulation tissue (Fig. 1A), whereas the second-degree lesion (Fig. 1B), though superficially similar, shows a fine gray-white meshwork of regenerating epithelium in the interstices among the granulations resembling imbedded mosquito netting. This signifies that some of the corium and epithelial-lined glands persist and that skin grafting will not be necessary. Healing of the third-degree lesions is a race between granulation tissue overgrowth and the skin's effort to cover the surface, and the more luxurious the granulation tissue now, the greater the scarring later.

The local dressing during the sloughing phase should not only minimize the inevitable sepsis but should also terminate the phase as soon as possible and give epithelialization a head-start over granulation tissue hyperplasia. We further encourage early epithelialization by applying pinpoint (Reverdin) skin grafts as soon as slough separates from a given area without waiting for the granulations to "clean up" to the extent traditionally advocated. Although the bacterial count is somewhat higher at this stage, the majority of the grafts do survive if held in place a few days with sea sponge pressure and seem to grow more vigorously than those placed upon older granulation tissue.*

Fig. 2.
Patient D. M., 10 days after admission. Burn covered with Foille.

Fig. 3.
Same patient a few weeks after final healing, which occurred on the 87th day.

A case illustrating this point is the patient, D.L., a four year old girl admitted with a fire burn (22% of body surface), third-degree on chest and abdomen and second-degree on face, neck, upper back and hands (Fig. 2). She was treated with Foille. Because of the extent of the burn, the grafting was done in two stages, 12 days apart. The lower half, grafted shortly after it became surgically clean, healed within 26 days. The upper area grafted at the second stage required 44 days for healing (Fig. 3). No change

*We have just begun to use Padgett's[18] calibrated dermatome for split thickness skin grafting, and have, so far, had gratifying results.

could be detected in the wound flora which remained consistently streptococcus hemolyticus and staphylococcus aureus. Evidently, the optimum time had passed when the later grafts were placed, although the granulations were rosy and healthy looking at the time.

Throughout the epithelialization stage, both the grafted third-degree burns and the regenerating second-degree are dressed with either cod-liver oil or pectin jelly (proposed for this use by Thomson[19] in 1938), for with the beginning of this stage we are no longer dealing with a burn as such, but with a granulating wound.

Daily or periodic tub baths have proved to be a most efficient method of mechanical cleansing and of loosening dressings and encrusted exudate without damaging delicate new epithelium. Plain tap water at a temperature of 95° F. is used. For a while salt was added to make a 2% solution, but this hypertonic bath showed no advantage over tap water.

The Controlled Study of Foille

A LITTLE over a year ago our attention was attracted by a new local application for burns called "Foille."* This is a stabilized, viscid, water-in-oil emulsion of several drugs in a base of Corn Oil. Among the chemical ingredients are benzocaine for analgesia, oxyquinoline for mild antisepsis, and calcium soaps which maintain the emulsion and produce a soft, protective precipitate with body exudates. Its non-toxicity and efficiency in experimental burns, published by Terrel[20] and enthusiastic case reports from various hospitals, especially in Texas,[21] decided us to carry out a controlled study of the agent. To date, 44 burns severe enough for hospitalization have been dressed with Foille. A control series of 41 as nearly as possible comparable burns have received the Wells[22] modification of Davidson's tannic acid treatment. This latter we had previously adopted as the best of the tanning routines, since it obviates anesthesia and allows a thorough, painless debridement while the patient is immersed in a warm tannic acid bath. In six additional patients, Foille and tannic acid were used conjointly in the same patient, the one being applied to one burned area, the other to another as nearly as possible comparable area. Although this is a small series, every case has been followed carefully by the author and a preliminary report seems justified after this first year's study. Needless to say, the general treatment of the two groups, such as fluid administration, blood and plasma transfusions, high vitamin diet, etc., has been identical.

The Foille routine is extremely simple. Since the agent is mildly antiseptic, an aseptic soap and water debridement under morphine sedation is sufficient. Within a few minutes of application (either by spray or soft camel's hair brush) there is marked relief of pain, due to the action of the benzocaine. A preliminary dressing of two or three thicknesses of sterile, Foille-saturated gauze is held in place by a few turns of clean bandage, and this is all kept constantly moistened with the agent under a heated cradle for 48 to 72 hours. At the end of this time the dressings and any accumulated debris and crusts are gently soaked off in a tub of warm tap water. Thereafter the lesions are kept covered with the Foille, but without the gauze dressings. Gentle mechanical cleansing is carried out in the warm bath every day or two, as already described.

The deeper control burns, as soon as the tannic eschar has been trimmed away from the granulation tissue, are also given frequent tubbings and in the intervals are dressed with cod-liver oil or weak Dakin's solution. As mentioned before, the burns of both series, when they reach the epithelialization stage, are dressed with pectin jelly or cod-liver oil.

In the two groups, age distribution and the number of adverse factors, such as extreme obesity, debilitating disease, etc., seemed reasonably comparable. The length of time between receipt of burn and the start of treatment was longer for the experimental than for the control group. Of the 41 tanned burns, 36 received treatment within six hours and only five after six hours. Of the 44 Foille treated burns, only 33 were treated within six hours and 11 after six hours, eight of these being one to five days after their injury.

Foille did not seem quite as efficient as the tannic eschar in controlling pain during the first days of the burn. However, this never was a significant factor, since two or three extra doses of morphine would control this.

TABLE I.

AVERAGE FIGURES FOR THE FOILLE AND TANNIC ACID METHODS OF LOCAL TREATMENT OF BURNS

Points of Comparison	Foille Group	Tannic Acid Group
Total area burned (in % of body surface)	11.4%	12.4%
Area first degree	1.0%	0.7%
Area second degree	8.0%	9.9%
Area third degree	2.4%	1.8%
Days till healed*	48.7 days	55.9 days
Hospital days*	43.7 days	54.7 days
Mortality	15.9%	24.3%
Clinical evaluation* (100% is perfect)	89.5%	86.6%

*The figures for these three items are averaged from less than the entire group, due to mortalities or to patients leaving prematurely. Thus, from the Foille series totalling 44 cases, 33 were averaged for days till healed, 34 for hospital days and 34 for clinical evaluation and for the tan series, totalling 42 cases, 26 were averaged for days till healed, 27 for hospital days and 28 for clinical evaluation.

In Table I, various critical data of the two groups are averaged for comparison. It will be noted that, although the average total area burned is slightly greater for the tan than for the Foille treated patients, the third degree involvement in the Foille series is considerably greater than that in the control series.

*This preparation has been supplied to us for this investigation by the makers, The Carbisulphoil Company, Dallas, Texas.

Healing time is a week less for the experimental cases than for the controls. Whether this will be borne out in a larger series remains to be seen. The only reason for including mortality figures at all in such a small series, is to show that the new application is apparently devoid of toxicity and at least as safe as the traditional tannic acid treatment. The numerical grade (higher for the Foille series) is averaged from the final evaluation by the author and interns of the degree of excellence of treatment in each case.

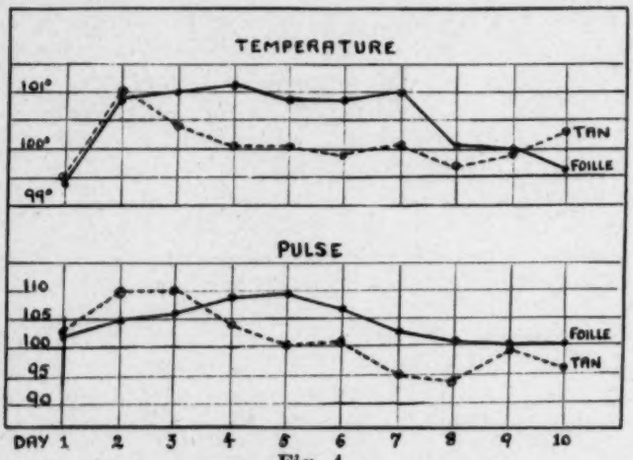


Fig. 4.
Average highest daily temperature and pulse curves of the Foille and tannic-acid groups during first 10 hospital days.

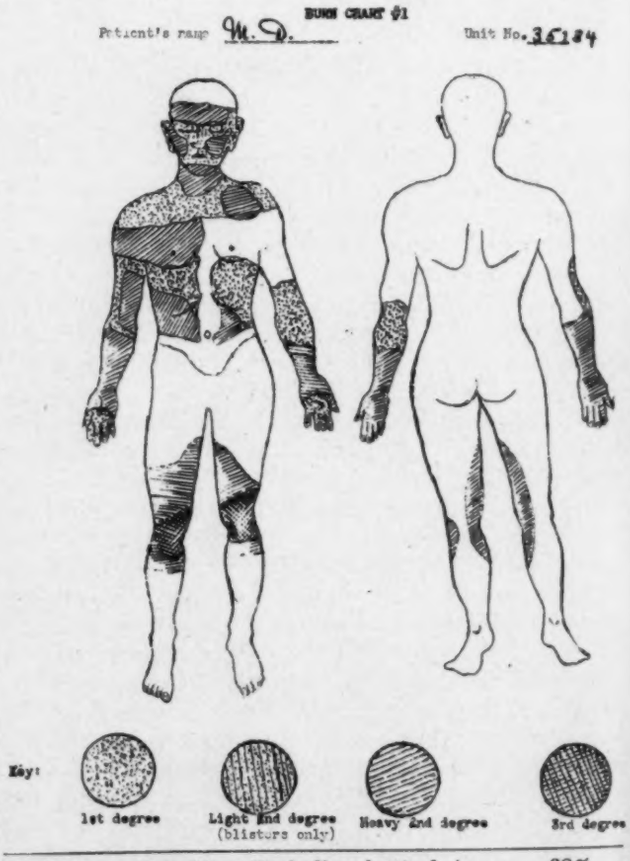
Fig. 4 shows composite temperature and pulse curves for the two groups for the first 10 hospital days. The curves represent the average highest daily temperature and pulse recording for the two series.

Deeper burns, especially those about the hands and flexures, seem to progress more favorably when treated with the new agent than when tanned. The soft, mildly antiseptic and water soluble coating produced by Foille is in sharp contrast to the tough tan eschar. During the sloughing phase this eschar unavoidably conceals pockets of pus and its removal is slow and painful, delaying skin graft. On the other hand, Foille, together with accumulated exudate and any separable necrotic tissue, is easily removed in the daily tub bath; and then a fresh application of the agent repermeates the wound. Under this regime, patients suffer less, grafting is permitted earlier and healing comes with less scar tissue and contracture.

Fig. 5
Patient V. M., shortly after admission. Tannic acid eschar on right leg, Foille on left. Burns of both legs apparently identical third-degree.

Fig. 6.
Same patient on 42nd day. Granulating wound on Foille side much smaller than on tan side.

One of the bilaterally burned cases treated on one side by tan and on the other by Foille, illustrates this. The patient, V. M. (Fig. 5) had sustained identical third-degree burns over the backs of both thighs and legs. The right side was tanned, the left side was treated with Foille. By the 42nd day (Fig. 6), the Foille treated, granulating lesion



Lower extremities (including buttocks)	38%
Trunk (including neck)	38%
Upper extremities	18%
Head	6%
Hand (¼ of an upper extremity)	2-3%
Foot (1/6 of lower extremity)	3%
Lower leg (1/3 of lower extremity)	6-7%
Thigh (½ of lower extremity)	9-10%

(Taken from Burkow)

Burn Estimate
Total area burned, 31%
Combined second- and third-degree, 19%

Fig. 7.
Burn chart of patient, M. D., indicating the depth and distribution of the burn which involved 31% of the body surface.

Fig. 8.
Patient M. D., shortly after admission. Burns are covered with Foille.

was only about one-third the size of the control.

Despite skin grafting, final healing was much delayed on both sides, by little pustular crusts which would heal in one place only to appear at another. At final healing there was no contracture on the Foille side, while on the control side there was about 10° of flexion contracture of the skin behind the knee.

A third case illustrating Foille treatment is M. D., who was admitted with first-, second- and third-degree burns of 31% of the body surface, as illustrated on the burn chart (Fig. 7). The photograph (Fig. 8) was taken about one week after admission. Fig. 9 shows the patient a few days before final healing, which occurred about

Fig. 9.
Same patient shortly before healing which occurred about the 89th day.

the 88th day. In Fig. 10 is shown the flexibility of the hands which had been burned between second- and third-degree.

In conclusion, we feel that Foille constitutes a happy therapeutic medium between extremes: on the one hand, the various leatherizing or tanning methods, on the other, Blair's [23] regime, consisting entirely of saline soaks and packs. We agree with the principles of Blair's treatment of deep burns, namely, that a tough eschar delays sloughing of dead tissue and that the earlier skin grafting is done, the less there will be of granulation tissue and scarring. But we feel that these ends are better accomplished by Foille than by saline alone. Foille is mildly antiseptic and assists in separation of slough, and it forms a soft protective easily removed coating. These qualities render it especially desirable in a busy, understaffed hospital, where simplicity and ease of dressings are essential and where the elaborate saline routine would be out of the question.

Fig. 10.
Same patient, showing flexibility of hands which were burned to between second- and third-degree depth.

We have been so much impressed with the reports of Hardin[24] and others on the results of Lohr's cod-liver oil treatment of burns that we have lately treated a few patients by this method. So far, it appears that with the cod-liver oil therapy, the sloughing phase continues longer than in Foille-treated burns and skin grafting is correspondingly delayed.

Summary

IN the early exudative phase of burns of any severity, the general treatment takes the predominant role and may decide between life and death.

This treatment aims at: (a) Plasma replacement; (b) liver protection; (c) combatting possible adrenal cortical exhaustion and increased plasma potassium.

2. Local treatment must not be underestimated, since through it prolonged sepsis and disfiguring contractures are minimized.

3. A preliminary report upon a new local application, "Foille," is presented. Thus far, Foille appears to be superior to the tanning method in the local treatment of burns, and also to have definite advantages over the cod-liver oil therapy.

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Working Conditions

—In the Painting Trades In Chicago—

Abstract by

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GREAT changes in the technique of the painting trade have taken place so that diseases which were common some 30 to 40 years ago have given way to a large extent to "new" ailments, due to the use of modern and more harmful materials.

An inquiry upon the subject was determined upon by the Painters' District Council No. 14, which covers Chicago and Cook County. This took the form of a "statistical survey" applying particularly to the year 1939, but including employment in January, 1940.

IN COMMON with the building trades in general, the painting trade has its share of seasonal unemployment. Based upon the reports of 3787 members received in the present survey, the average time worked during 1939 was 6½ months. This involved reports from 10 local unions in which the average age of workers was 47 years. Less than 5% of members worked the full 12 months and 39% worked less than 6½ months. Of this 39%, 29% worked three months or less. "It is from these workers with less than four months' work that the W. P. A. recruits its forces." Even in the "prosperous" year of 1929 the average working time was only seven months. In the years 1908-1910 Local Union 194 reported the average working time as eight months per year.

The population of the City of Chicago increased from 2,185,283 in 1910 to approximately 3,384,556 in 1940. In 1910 the conditions gave work to 15,000 painters. The same conditions in 1940 would have required 23,231, but the changes in method and materials have made about 8,231 painters superfluous as compared with the old basis.

In January, 1940, the number of painters employed at full time was 8%, part time 23%, no work 69%. "Low wages and no work cannot produce a strong, healthy and intelligent working class, to which may be added poisoned atmosphere and the speed-up system when work prevails."

Citation is made from the report of DR. KRONENBERG, Chief of the Division of Industrial Hygiene, Illinois State Department of Public Health, based upon a medical examination of 213 members of Painters Local Union No. 194 in the early spring of 1938:

"With the advent of fast drying paints, the time for covering an area has been sharply reduced; in this increased rate of work lie several important health factors. First, fast drying paints imply higher volatilizing solvents and diluents, which in turn result in a more heavily contaminated working environment. Secondly, an increased rate of work implies higher respiratory rate. This increased respiratory rate results in the inhalation of more contaminated air than previously. Thus the painter today is subject to a greater hazard than formerly."

DURING 1939, 186 accidents were reported by the 3,787 members of the component local unions. Of the reported accidents, 145 occurred during regular working hours—56 in the forenoon and 89 in the afternoon (each being a three-hour period). Closer analysis showed that the incidence of accidents was 9% in the first hour, 11% in the second hour and 18% in the third hour of the *morning*, followed by 10% in the first hour, 21% in the second hour and 30% in the third hour of the *afternoon*. Defective scaffolds accounted for approximately 36% of the accidents, falls from scaffolds 41%, and "lifting rupture" 25%. The average loss of time per accident was three months.

The painting season, while averaging 6½ months per year, is divided into spring and fall seasons of three months each: April-June and August-October. The number of accidents reaches its height the last month of each season. On the other hand, during the dull months when an estimated 30% was employed, there were approximately double the number of accidents as compared to the busy months. This raises the question of the psychology of accidents: "No doubt the mental or psychological condition with its worry, fear of losing the job and the consequent speeding up and taking chances, may be largely responsible for the proportionate increase in accidents during the dull months."

An inquiry was made as to the extent to which members suffered from seven selected symptoms. From 16 local unions, a total of 1766 reports were received, summarized as follows: Pain in arms and shoulders 30%; failing vision 26%; constipation 20.5%; pain in knee 19.5%; lack of appetite 18%; dizziness 14%; nausea 8%. Regarding *injury to the knee*, usually attributable to "bursitis," a survey in 1922 reported 11% so afflicted. *Dizziness* and *nausea* are associated with working in closed quarters with poor ventilation. "*Constipation* (is) an ailment so common in this country that it is hard to differentiate between occupational constipation or any other." The painter knows that lead is one of the predisposing agents, but white lead has been largely displaced today for interior use. However, it may be sufficiently used for outside work to produce some part of the complaint of constipation. For *failing vision* the case is cited of a painter who received total disability benefit in 1937 for total blindness who was passed upon by noted oculists, the inference being poisoning from lead, methyl alcohol, benzol and other poisonous materials used in the trade.

A Report by J. A. RUNNBERG, Statistician, Painters' District Council No. 14.

Tuberculosis in Industry

—Proceedings of a Symposium on Tuberculosis in Industry, sponsored by the Trudeau School of Tuberculosis, Saranac Laboratory, Saranac Lake, New York, June 9-14, 1941—

Reported by

C. O. SAPPINGTON, M.D., Dr. P.H.

ONE of the most important meetings held in the United States was the Symposium on Tuberculosis in Industry at Saranac Lake, New York, June 9 to 14, 1941.

Realizing the increasing importance of the subject, various authorities had been gathered from all over the country to give their views and to share in the discussions of the different phases of the general subject.

As it was necessary to make some adjustments, on account of the absence of some of the speakers, the abstracts here reported will follow exactly what took place at the meeting.

It should be noted that the full presentations are to be published and distributed by the National Tuberculosis Association, 1790 Broadway, New York City.

The program follows:

Monday, June 9: Morning

THE DISEASE, TUBERCULOSIS.
Introduction—DR. LEROY U. GARDNER, Saranac Laboratory.
"Tuberculous Infection, Sources and Modes of Transmission"—DR. LEROY U. GARDNER.
"Pathology"—DR. ARTHUR J. VORWALD, Saranac Laboratory.
"Diagnosis"—DR. FRANCIS B. TRUDEAU, Saranac Lake. N. Y.
"Treatment and Rehabilitation"—DR. FRED H. HEISE, Trudeau Sanatorium.
"Epidemiology" — DR. L. L. LUMSDEN, U. S. Public Health Service.

Monday, June 9: Afternoon

INCIDENCE OF TUBERCULOSIS IN INDUSTRIAL GROUPS.
"Comparative Mortality Statistics on Tuberculosis in Various Industries"—DR. LOUIS I. DUBLIN, Metropolitan Life Insurance Co.
"Disabling Morbidity from Tuberculosis"—DR. W. M. GAFAFER, U. S. Public Health Service.

Tuesday, June 10: Morning

PREDISPOSING FACTORS, THEORETICALLY SIGNIFICANT.
1. Non-Specific Factors:
(a) "Heredity, Race, Age, Sex, Selective Employment, Economic Status"—MISS JESSAMINE S. WHITNEY, National Tuberculosis Association.
(b) "Influence of Foreign Birth"—DR. O. A. SANDER, Milwaukee, Wisconsin.
(c) "Influence of Nutrition" — DR. J. A. JOHNSTON, Henry Ford Hospital.

Tuesday, June 10: Afternoon

PREDISPOSING FACTORS, THEORETICALLY SIGNIFICANT.
2. "Specific" Occupational Factors:
(a) "Respiratory Irritants — Dusts, Fumes and Gases"—DR. LEROY U. GARDNER.
(b) "Lead Absorption and Lead Intoxication"—DR. ELSTON L. BELKNAP, Milwaukee, Wisconsin.

Wednesday, June 11: Morning

SPECIFIC Occupational Factors—(cont'd.)
(c) "Influence of Fatigue as Observed in the Automobile Industry" — DR. FRED B. WISHARD, Delco-Remy Division, General Motors Corporation.
(d) "Influence of Temperature and Humidity"—DR. ANNA M. BAETJER, Johns Hopkins School of Hygiene and Public Health.
(e) "Influence of Posture and Trauma"—DR. E. N. PACKARD, Saranac Lake, N. Y.

Wednesday, June 11: Afternoon

INCIDENCE AND CAUSATION OF TUBERCULOSIS, VARIOUS INDUSTRIES.
1. "Office Workers"—DR. HAYNES HAROLD FELLOWS, Metropolitan Life Insurance Co.
2. "Tobacco and Cigar Makers" — DR. CHARLES-FRANCIS LONG, Bayuk Cigars, Incorporated.

Thursday, June 12: Morning

INCIDENCE AND CAUSATION OF TUBERCULOSIS, VARIOUS INDUSTRIES.
3. "Garment and Laundry Workers" — DR. HERBERT R. EDWARDS, New York City Department of Health.
4. "Cement and Gypsum Workers"—DR. D. M. BRUMFIEL, Saranac Laboratory.
5. "Grain Handlers" — DR. ADELAIDE ROSS SMITH, New York State Department of Labor.

Thursday, June 12: Afternoon

INCIDENCE AND CAUSATION OF TUBERCULOSIS, VARIOUS INDUSTRIES.
6. "Iron and Steel Workers"—DR. A. G. KAMMER, Inland Steel Co.
7. "Foundrymen"—DR. LEONARD GREENBURG, New York State Department of Labor. DR. ALTON S. POPE, Massachusetts Dept. of Public Health.

Friday, June 13: Morning

INCIDENCE AND CAUSATION OF TUBERCULOSIS, VARIOUS INDUSTRIES.
8. "Granite vs. Marble Cutters"—DR. LOUIS BENSON, Vermont Sanatorium.
9. "Hard Rock Miners"—MR. DONALD E. CUMMINGS, Saranac Laboratory.
10. "Medical Students, Nurses and Laboratory Workers"—DR. J. BURNS AMBERSON, Bellevue Hospital.

Friday, June 13: Afternoon

METHODS OF CONTROL.
"Administrative Procedures within the Plant"—DR. W. A. SAWYER, Eastman Kodak Co.
"Public Health Relationships"—DR. LEVERETT D. BRISTOL, American Telephone and Telegraph Co.
"Case Finding Procedures"—DR. WILLIAM SIEGAL, New York State Department of Health.

Saturday, June 14: Morning

THE Viewpoint of the Insurance Carrier on Tuberculosis in Industry" — MR. HENRY D. SAYER, Compensation Insurance Rating Board.
"The Viewpoint of a State Compensation Commissioner"—MRS. EMMA S. TOUSSANT, Massachusetts Department of Industrial Accidents.
"A Labor Viewpoint of Tuberculosis in Industry"—MR. MATTHEW WOLL, American Federation of Labor.
Closing Remarks—DR. LEROY U. GARDNER.

Monday Morning, June 9

DR. LEROY U. GARDNER, in introducing the subject of the Symposium, stated that attention has been focused on industrial health and occupational difficulties, hence the importance of the consideration of the subject of "Tuberculosis in Industry." Environmental factors are often blamed, rather than the factors in the two-thirds of the time the man spends outside of employment.

The case for infection and re-infection is apparently proved. Most primary infections occur before the age of 25 and reactivation, if any, comes afterward. The role of nutrition is difficult to assess. The part played by silica dust can be proved experimentally.

In view of these circumstances, it was decided to ask a group of experts to give their experiences with reference to the prevalence of tuberculosis in certain industrial groups. Information thus obtained could be useful in clarifying the situation. It is recognized that in medical students and in nurses, there is an infection hazard; it is also believed that in other occupations there are certain accessory factors which are important to consider.

DR. GARDNER also opened the Symposium proper by discussing the subject of "Tuberculous Infection, Sources and Modes of Transmission," later following with a discussion of "Pathology."

An important fact in transmission is that the tubercle bacillus does not survive long except in the body of the host—the bacillus dies in a short time outside of the human body. Sunlight is most effective in killing the bacillus, in about 10 minutes. Ultra-violet light is also effective in a few minutes. On desiccation, or drying, it takes about 10 days. Pasteurization accomplishes the same result in approximately one-half hour. Of the chemicals, cresols and phenols are better. as they dissolve the mucus. Formaldehyde gas is used for fumigating purposes, but it must be said that the best germicides are soap and water, and sunshine.

The most constant sources are human beings, but the bovine type may be transmitted from cattle.

As to the modes of transmission, occasionally a surgeon or a nurse becomes inoculated by an infected instrument. Ingestion can occur, as in children or young adults, from milk. Hand-to-mouth infection can occur from sputum-contaminated objects, but this is relatively a minor source of transmission. Spray inhalation (droplet infection) is by far the most important and takes place in the immediate vicinity only—two to three feet away from the car-

rier. This forms an important basis for the protective program in the search for carriers.

In approaching the pathological phases, it is important to realize that more than mere exposure is required to produce the disease—the bacilli must enter the body and grow. Natural resistance is rather general in civilized races. Re-infection probably raises the resistance in some instances, while other factors depress the resistance.

Primary infection is usually transitory and is not accompanied by clinical symptoms. If a pneumonic patch is formed, it is the result of spread from the microscopic focus of first localization and as such it causes symptoms. The primary infection tends to subside and heal rather promptly. Extension to lymph nodes occurs, the tracheobronchial nodes being affected if the lesion is in the lungs.

Primary tubercles may occur anywhere, but are mainly found in the pleura. Apical lesions mean re-infection. Calcification occurs by attracting the salts from the bloodstream.

Ordinarily the healed primary tubercle seen in adults does not contain bacilli (1%).

A most important factor to remember is the sensitization of cells, providing the reaction to tuberculin.

Resistance from the primary lesion is temporary, there being active resistance while the lesion is active.

In re-infection, some believe that exogenous re-infection takes place constantly in adult life. At Saranac, it is thought that most re-infections are acquired before the age of 25, with possibly a few exceptions. Lesions occur usually in the apex or upper lobe, with no associated lymph node involvement, which differs from the primary focus. There is a slow spread, but not infrequently the lesion is accompanied by cavitation; there are always symptoms. There is a tendency to heal the pneumonic patch, with also a tendency to scar formation, with less emphasis on degeneration. Diagnosis by x-ray should not be difficult, because not many other lesions simulate this one.

Extension by bronchial aspiration is a usual occurrence, although occasionally it takes place by bloodstream. Clusters of tubercles are found around the terminal bronchioles. Results may express themelves as caseous pneumonia or hard, fibrous, and calcareous formations. There are all degrees of acuteness and chronicity.

Cavities serve as reservoirs for the bacilli and as a source of infection. Therapy is naturally directed against cavity formation and to promote closure. Such cavities may develop in any part of the lung, rapidly or slowly, and may have thick or thin walls, probably due in part to the amount of disease in the surrounding tissue. Cavitation is also the source of hemorrhage because the walls are quite vascular, or there may be ulceration of the larger vessels.

Excellent lantern slides of pathological specimens, as well as x-rays of the chest, were used to illustrate the various points.

In summary, it was stated that primary lesions are localized foci occurring anywhere, less often in the apex and are accompanied by fairly prompt healing. Re-infection lesions are apical, more often acute than chronic, accompanied by symptoms and often healing with residual foci. Dissemination by bronchial aspiration produces an acute pneumonic lesion and also chronic proliferation. Cavities represent sources of spread and causes of hemorrhage.

DR. FRANCIS B. TRUDEAU spoke on "Diagnosis." The diagnosis is usually not difficult. Earlier diagnosis probably is not made because of insufficient time and care in examination and insufficient care in the taking of histories.

At Saranac, in 84% of the patients the onset is catarrhal or insidious. There is productive cough which does not clear promptly. Fatigue, indigestion, and afternoon temperature are important. Attacks of pleurisy frequently precede disease development, recognized clinically.

Physical examination often shows nothing; moist rales in the upper third of the chest are really diagnostic. Rarely can activity be diagnosed by examination alone. Stereoscopic films are a necessity—if no abnormality is found, then the chances are over 90% that there is no tuberculosis.

Diagnosis of activity is really difficult on the film alone—probably increased temperature is more diagnostic for the general practitioner.

Surveys are important and are being done considerably now in schools and industries, as well as other groups. As examples, the du Pont Company was mentioned, and at Yale all freshmen are required to have special examinations. Such surveys have reduced the number of cases on sanatorium care from 25 to three.

Sputum examinations should be made on all persons with persistent cough for over one month and will often uncover cases of infection. Experience has shown that in minimal cases 80% have positive sputa—in moderately advanced cases, 90%—and in advanced cases, 97% plus. The Gaffky bacterial count has been found to be of great importance in rating disability.

In resumé, the important cardinal points in diagnosis are: (1) history of blood spitting (greater than 1 dram); (2) history of idiopathic pleurisy with effusion; (3) persistent moderately coarse rales in the upper two-thirds of the chest; (4) definite parenchymal involvement as shown in the x-ray film of the chest; and (5) tubercle bacilli in the sputum.

In the discussion, DR. ELSTON BELKNAP asked about the value of the sedimentation test. It was stated that if the sedimentation rate is high, patients are restricted as to physical activities; it should be remembered, however, that the use of the sedimentation test is not necessary for diagnosis.

DR. FRED H. HEISE discussed "Treatment and Rehabilitation." This discussion was limited purposely to those of industrial age. Most persons recover, there being roughly a group of approximately 10% which constitute problem cases.

Two clases are considered—those having previous infection (re-infection type) and the spreading first infections, or primary types. All varieties of lesions develop, some without symptoms and other persons are quite ill.

Treatment is largely educational and also involves reexamination in healed types. During illness, active treatment is important.

A third group might be added (those who have productive cough only) education being important here in conveying to the patient what he can do to control his own disease and prevent transmission.

Rest should be both mental and physical; collapse therapy assists the physical rest of the lung; education is better carried on in an institution because of the time required. As to food, mineral salts, vitamins and proteins are stressed.

The length of treatment depends upon the stability of the lesions as shown by x-ray films. Graduated physical and emotional exercise should be a matter of prescription. Most persons will be able to return to their former occupations, while others will have to be educated along additional lines.

As to the condition of positive sputum without disability, such persons should have work, but should be isolated if in industrial groups.

In summary, education is necessary and is best given in an institution. The disease is very chronic and subject to relapses; provision against relapses must be made through rehabilitation and educational measures.

There was a long discussion of this presentation by DRS. DUBLIN, NEWCOMB, POPE and MR. CUMMINGS. Among other things, it was stated that collapse may reduce the morbidity by taking the carrier out of circulation. The idea of "villages" is a good one. A comparison of the relative values of pneumothorax was made. About 30 to 50% show a "conversion" by pneumothorax in contrast to the 80 to 90% often reported.

DR. ARTHUR J. VORWALD, in the absence of DR. L. L. LUMSDEN, spoke on the subject of "Epidemiology." Epidemiological studies have for their objective an analysis of various factors and the planning of a future course. Comment was made about the early origin of these studies in Galen's time and the persistency of them over many years.

There has been a reduction from 30% mortality in the 17th century to 7% in 1937.

Graphs of tuberculosis mortality, according to Dublin and Whitney, were shown depicting a reduction from 200 per 100 thousand in 1900 to 50 per 100 thousand in 1940.

It is important to consider the host factors of resistance and environment and also natural and acquired immunity.

Graphs of the United States experience in 1938 were shown, with reference to age, race and sex. There was a definite rise during adolescence and a continued rise in the males. High rates persisted in the females through the child-bearing period and decreased at the menopause. The high death rate in old age is probably due to a generally decreased resistance to all types of infection.

The disproportion of deaths in the negro population in urban centers is probably due to the economic status and late hospitalization, as shown by the Pittsburgh and Cincinnati studies.

During World War I, the rate rose rapidly in Germany and during the same period was lower in England and still lower in the United States.

The Indiana survey of 1930 showed high rates in low economic groups.

In conclusion, it was stated that the factors determining reduction of rates are natural selection—better hygiene—better sanatorium facilities—and higher living standards.

Monday Afternoon, June 9

DR. LOUIS I. DUBLIN presented the subject "Comparative Mortality Statistics on Tuberculosis in Various Industries," using six tabulations, the details of which will be published by the National Tuberculosis Association.

In a study of occupational incidence of tuberculosis over a period of 30 years, it was found that pulmonary tuberculosis was the greatest cause of death, 20% in 1911 as compared with the present percentage of 6½%. The mortality in male wage earners is only one-sixth (in 1940) of what it was in 1911. If the death rate declines at the same rate, pulmonary tuberculosis will be only a minor cause of death in several decades.

Industrialization in general shows higher comparative rates. The important age group is 25 to 34, since only a maximum of 9% decline has occurred.

In the chart of the mortality due to respiratory tuberculosis, the highest rate for industrial males occurs in the group 55 to 64, the highest rate for U. S. white males occurs in the group 65 to 74, and the highest rate for ordinary males in the group 65 to 74.

In the 1935-39 experience, it was shown that males have twice the rate that females do. The greatest drop in mortality occurred in the period 1918-21.

The figures of the Registrar-General of England and Wales are really the most dependable and show that the mortality increased according to low economic status—that direct occupational factors seem to have little effect—the economic level being the most important.

Considering the various occupations according to the same distribution, emphasis was placed on occupations with a silica dust exposure. According to the policyholders' experience of the Metropolitan, miners, stonecutters, and chippers had higher rates than others, the excess over the average being 61%.

In conclusion, it was stated that a small number of occupations still produce an excessive number of cases and deaths. The estimated number of persons is approximately 500,000. Such rates are particularly high where there is an exposure to silica dust. Industrial hygiene has an active program of concentration on the control of the factors producing the higher rates involved in these occupations.

DR. DUBLIN'S paper was discussed by DRS. GAFAFER, SANDER, BRISTOL, SAPPINGTON, VORWALD and MESSRS. CUMMINGS and COOK.

DR. W. M. GAFAFER discussed the subject "Disabling Morbidity from Tuberculosis."

In this it was proposed to examine the morbidity rates in the industrial workers, as given from reports of sick benefits, relief and other plans. The data were taken also from supplemental reports from Scotland with reference to disabling sickness.

Reference should be made for details to the proceedings as published by the National Tuberculosis Association, as only a few of the important points will be given here.

McKinley names two important factors for the upward trend of disability due to chronic diseases, first, the aging of the population and second, the decline in mortality. In general, tuberculosis declines past the age of 35 years, while heart and cancer cases increase.

With reference to American figures, these have been limited to data as reported to the U. S. Public Health Service, by 49 organizations reporting during the past 15 years. Since there is a waiting period of seven days, this and the fact that maximum benefits vary from several months to a year affect the data. A sound comparison of the various industrial experiences is difficult because of the variability of provisions. In this group, iron and steel organizations constitute 45%, public utilities 20%, and miscellaneous industries 35%.

As to tuberculosis, there was a varying rate of 0.7 to 1 in the beginning cases. A downward trend was experienced from 1925 to 1933, and from 1934 to 1939 the trend was less rapid, but still downward.

In conclusion, attention was directed to the trends as before mentioned.

Tuesday Morning, June 10

OWING to the untimely death of MISS JESSAMINE S. WHITNEY, it was necessary to omit the first paper of this session with reference to "Heredity, Age, Sex, Race, Selective Employment, Economic Status," as a discussion of "Non-Specific Factors."

DR. O. A. SANDER presented the subject of "Influence of Foreign Birth."

The factors of predisposition are so numerous that it is hard to evaluate them singly; this discussion will be confined to the re-infection type of lesion.

Because there is a lowered constitutional resistance to infection, there is therefore a slow development of immunity. However, if the spread of bacilli can be prevented, heredity need not be seriously considered. Experiences in colored groups have been satisfactory when they are supervised properly. The rates varied inversely with the economic status, as demonstrated by lantern slides. However, persons of lower economic status and those who are poorly nourished usually drift into the lighter types of labor. A great deal of tuberculosis has been found among applicants for unskilled jobs.

A comparison of persons from siliceous dusty occupations and non-dusty groups showed a definite rise in the later decades of significant tuberculous lesions and healed ones, among persons exposed to siliceous dust.

A comparison of urban and rural areas showed the death rate much higher in the former, in the Milwaukee experience. Foreign-born persons showed much higher rates.

With reference to exogenous infection, in a series of 20,000 examinations, of which about 7000 have had serial films, in no instance was exogenous infection seen to develop after the age of 40. An x-ray film demonstration was given in illustrating this principle. It is believed, therefore, that there has been a rapid decrease of exogenous infection. However, younger persons are still developing re-infection lesions, according to the experience of the speaker.

Although definite conclusions are not possible, the following summary was given: (1) the factor of heredity is important in the development of resistance, but otherwise not; (2) the racial factor is important because of the economic influence; (3) foreign-born mortality statistics showed twice the mortality rate among males as compared with females in the later decades (this may be the industrial influence); (4) most cases of re-infection occur earlier than believed by a great many observers; (5) foreign birth may be a factor in the determination of resistance and increase in the rates; and (6) early adult life still remains the important age period for the development of an infection.

This presentation was discussed by DRS. GARDNER, POPE, SAWYER, SHAFER, KAMMER, SIEGAL, and HOAGLAND.

DR. J. A. JOHNSTON discussed the "Influence of Nutrition."

So far, experimental work on animals really does not offer much data on this subject.

Lantern slide material was shown depicting the decrease of death rates in a children's group (64 to 14) because of proper nutritional supervision.

The Denmark statistics relative to tuberculosis mortality show rates inversely proportional to the available meat supply and the actual eating of moderate amounts of meats.

It is important in nutritional studies to understand that in the metabolism of fat there is about one-third of a gram of water laid down per gram of fat, whereas one gram of carbohydrates lays down three grams of water.

It is also important to remember that usually persons run pretty well to certain types of body build, regardless of a number of extraneous factors.

In making this investigation, it was first desired to ascertain whether endogenous infection really occurred and then to find out what factors there were in the background.

In our nutritional work we must have due regard for the fact that nitrogen is necessary for muscle building and mineral salts for bone.

It has been shown by experience that focal infection and glandular infection certainly are definite factors which have to be taken into account in maintaining a nitrogen balance.

A study on 30 children for a period of a year showed that it was necessary to give 130 grams of protein which is a lot, since adults only need half as much.

It was found easy to keep a positive calcium balance on 1000 milligrams of calcium if the child was not losing weight, in which case double the amount was needed.

An illustrative case of a child was mentioned in which there was a negative protein balance, but the child went right into a positive balance after a tonsillectomy (this apparently was an instance of malnutrition in the presence of adequate intake).

Infection lowers the storage of calcium and at puberty there is a tendency to be unable to store protein. Some adolescents need a small amount of thyroid extract, but it should be remembered that thyroid extract causes a catharsis of lime.

Prolonged bed rest tends to demineralization and loss of protein both in a child and adults. Here a little thyroid improves retention.

Examples were given of tuberculosis cases with respect to the storing of calcium and nitrogen. A negative balance seems to precede infection and a positive balance promotes healing. Dicalcium phosphate is useful and vitamin D will help if used in small doses.

In summary, it was stated that nutrition plays a role in the development of tuberculous lesions, but the metabolism, puberty, and food utilization are also factors which must be given due consideration.

This presentation was discussed by DRS. GARDNER, BELKNAP, VORWALD, and MR. CUMMINGS.

Tuesday Afternoon, June 10

DR. L. U. GARDNER in considering "'Specific' Occupational Factors," discussed the role of "Respiratory Irritations—Dusts, Fumes and Gases."

The one substance that is recognized as having a specific irritating reaction, is silica dust which possesses a unique reaction. Many people are exposed to pulmonary irritants of various kinds and never develop tuberculosis.

Lobar pneumonia does not have an appreciable effect on tuberculosis—some authorities think that it leaves tuberculosis in a better condition.

Experimentally one cannot superimpose tuberculosis on pneumonia in animals. Influenzal pneumonia is a different type and is especially predisposing to tuberculosis infection.

There is a greater incidence of tuberculosis in free silica exposure and the reaction is similar to the inflammation produced in tuberculosis. Free silica dust causes necrosis in high concentrations and in small particle sizes, creating a condition favorable to the growth of tubercle bacilli, which is a specific reaction. Investigators have not yet been able to show that other minerals will produce such a reaction.

It is believed that silicatosis is a pernicious term. Asbestosis does not predispose to tuberculosis and, therefore, is not a specific irritant in that respect.

Vapors and gases are not specific irritants with respect to tuberculosis. Price decided in an experience covering 12 years' figures that there was no increased incidence of tuberculosis in soldiers exposed to various types of gases and vapors. In experimental work, he was also able to show that there is no increase in susceptibility to tuberculosis.

As another example, Evans, of the du Pont Company, in making observations relative to various exposures to irritants, found that there was no more tuberculosis in those departments than in departments without such exposures and that there was no reactivation of infections after 10 years of such exposures.

As examples of other industrial exposures, there has been no increase in the rayon industry. Sulphur dioxide has not been regarded as a specific substance. Although welding with coated rods has been suspected as a specific irritant, animal experiments are now in progress, and it is believed that the results will not show anything specific.

In conclusion, there are only two specific reactions known—that of free silica dust and tuberculin—the latter in large doses and not the regular tests as made.

DR. ELSTON L. BELKNAP, in continuing the discussion on "'Specific' Occupational Factors," talked with respect to the effects of "Lead Absorption and Lead Intoxication."

According to figures from the Registrar-General's office, the hand and machine compositors in the printing trades had a 16% higher tuberculosis rate than the general population. Hamilton has also raised the question of why tuberculosis occurs in greater incidence among printers than among employees of smelters and storage battery plants.

A distinction must be made between lead absorption and lead poisoning. One must also understand the values of normal lead in urine and blood.

It is well to keep in mind that certain soluble lead compounds are encountered frequently in industry, such as in the storage battery industry, brass foundries, cutting painted scrap, and others.

In the speaker's experience, there has been no case of disability occurring among workers who have shown evidence of lead absorption in a group of storage battery employees under medical supervision. Nor has there been any predisposition to tuberculosis in this same group. Furthermore, the loss of time on non-tuberculous cases of disability has been less than in the normal population.

Lantern slides were used to show clinical findings of a case of severe lead intoxication with disability, which was treated with calcium therapy. Intravenous calcium chloride has a specific reaction in the relief of lead colic.

In summary, in a group of 97 workers in a heavy lead exposure, 77 are still working. The general health has been good and there has been a low incidence of non-tuberculous infection. Three of the workers showed definite parenchymal lesions, one active; two showed advanced linear fibrosis.

DR. FRED B. WISHARD discussed the "Influence of Fatigue as Observed in the Automobile Industry."

With respect to this problem, one is concerned with the elimination of unnecessary motion, industrial health in general, and a proper analysis of cases. It should be pointed out that with the mechanization of the assembly lines there is little physical work necessary in this industry. Time studies of various operations have been made to eliminate unnecessary movements. The factory layout has also been studied with reference to comfort and efficiency.

The classical definition of fatigue by Florence was mentioned and briefly discussed.

One reaction to the increased hours on the part of some employees has been that some of them at least are tired

enough to go to bed instead of "prowling around" and becoming more tired because of outside activities.

It is important to realize that the real basis for fatigue is often found in physical defects.

In the experience of this organization, for the past 10 years, with an average of 7000 employees (4000 men and 3000 women) there were 13,000 cases of non-occupational sickness and accidents. In the same group, there were 87 cases of active tuberculosis in the 10 years cited, 32 of which had a positive sputum.

There has been great emphasis on cooperation with the family doctor which has been carried out on these cases. The family doctor can send the employee for chest x-ray to the company and also have all the members of the family x-rayed. Hospitalization is always accomplished in the neighborhood if possible. In 32 cases collapse therapy was carried out at the hospital.

In conclusion, it is believed that fatigue has played a very small part, if any, in the production of tuberculosis in this industrial group.

There was a discussion of this presentation by DRS. GARDNER, SAWYER and KAMMER, and MR. CUMMINGS.

Wednesday Morning, June 11

CONTINUING the discussion of the "'Specific' Occupational Factors," DR. ANNA M. BAETJER talked on the "Influence of Temperature and Humidity."

Environment may affect the virulence of the organism and the resistance of the individual. These are important when considering the problems of the effects of temperature and humidity, which are difficult to separate from other related factors.

For the purpose of survey, three industries were selected, the laundry industry, textiles, and coal mining. After a very critical analysis of the figures from these three industries, it was concluded that there were no specific effects of temperature and humidity with regard to the tuberculosis rates.

In cotton weavers, the death rates for all diseases and also for tuberculosis were higher in humidified sheds than in dry sheds, in English weavers, but the rates were below average anyway. Neither is there any conclusive information with respect to occupations involving exposures to high temperatures without high humidity.

In a survey by Chapman and Cowells, 150,000 deaths were analyzed with reference to social and economic factors, together with climate, the latter of which was of minor importance. Most important were hours of sunshine, according to the correlation coefficient. The diurnal range of temperature, amount of precipitation, altitude and relative humidity, taken together meant something, but none of them alone.

Another study at Johns Hopkins showed that when the socio-economic factors were held constant, climate had no direct relationship.

In the small amount of experimental work which has been done on animals, there have been no definite results.

As to the effect of temperature and humidity on the organisms, prolonged speculation has not been productive of anything definite.

In conclusion, it was stated that there was no real evidence of any kind, either clinical or experimental, that temperature and humidity have any direct effect upon the tuberculosis rates.

DR. BAETJER'S presentation was discussed by DRS. GARDNER, SHAFER and BRISTOL, the latter mentioning a study of 1000 telephone operators in a modern air-conditioned building, comparing them with a control group in a naturally ventilated building—there being no difference in absenteeism due to sickness, either in incidence or duration; it was pointed out, however, that there was an exposure of only eight hours a day in these occupations.

DR. E. N. PACKARD spoke on the "Influence of Posture and Trauma," concluding the section on "'Specific' Occupational Factors."

There have been many theories relative to the effects of posture that have not really been proved. On the other hand, trauma is definitely associated in some cases of tuberculosis.

Bacteremia may be the mechanism of developing extra pulmonary foci after an injury (10% of cases show bacteremia). Trauma may by producing a *locus minoris resistentiae* be a factor in the production of tuberculosis symptoms. However, on the other hand, trauma may have nothing to do with the course of the disease.

Trauma may vary greatly in type, but we are limited in this discussion to one event, remembering that severity is no criterion.

A case history was presented illustrating a previous tuberculous pleurisy which had cleared up. Following an automobile accident, and in two weeks subsequent to the accident, the pleurisy was lighted up. (The probable explanation was the crushing of pleural tubercles by the slight injury involved.) Ornstein feels that traumatic effects may appear within 24 hours to two weeks after the traumatic event; others think that there is no particular limit to when such traumatic effects may occur, while some say one month should be the limit.

Certainly it is important that all injured individuals should have x-rays taken of the chest.

A traumatic relationship may depend on (1) traumatic inoculation with the tubercle bacillus; (2) the production of a place of minor resistance; (3) the lighting up of an unsuspected focus; and (4) an aggravation of a known tuberculosis.

In conclusion, it was stated that there are relatively few cases in which trauma has a distinct relationship to tuberculosis. It should be remembered that many individuals harbor the tubercle bacilli, that trauma does not initiate the disease, and therefore it is difficult to come to a definite conclusion. However, when tuberculosis does follow an injury within two weeks it is believed that a relationship may be established.

DR. CHARLES-FRANCIS LONG, in beginning the section on "Incidence and Causation of Tuberculosis in Various Industries," discussed experience with "Tobacco and Cigar Makers."

In this study among 80,000 employees, the tuberculosis rate was 151 per 100,000 as compared with 251 per 100,000 in the general population of Philadelphia.

Comparative studies have shown that the tuberculosis incidence in Philadelphia is less than the expected incidence for the general population, and furthermore that tobacco dust exposure does not change the fluoroscopic appearance of the chest. In 536 cigarette workers, for instance, (in another plant) there were six clinically significant cases of tuberculosis.

In the fluoroscopic experience, there have been 8,947 examinations in this group in four years, of which 7,013 were original examinations and 1,934 were rechecks. In this group, the 18 to 30 age group was the largest and also women exceed men considerably in number.

In fluoroscopic examinations, there are two classifications: clinically significant and not clinically significant, resort being made to stereo films of the chest for a decision. The usual findings are an accentuation of the hilus markings, grade II, and a mild fibrosis of the vessel markings. The group for observation also includes the occurrence of calcareous deposits and the primary complex, each year there being fewer in the observation group.

Of the 19 cases of clinically significant tuberculosis discovered, 12 were found on employment examinations and the remainder on periodic examinations.

The discovery rate for tuberculosis cases on total fluoroscopies made was 184 per 100,000 in 1937—201 in 1938—269 in 1939—196 in 1940—and 205 in 1941.

DR. LONG'S presentation was discussed by DR. GARDNER and MR. CUMMINGS.

Wednesday Afternoon, June 11

DR. HERBERT R. EDWARDS, in continuing the discussion of the "Incidence and Causation of Tuberculosis in Various Industries," spoke with reference to "Garment and Laundry Workers."

Of the 25,000 laundry workers in New York City, there were 252 on whom data were secured.

There were 26,058 persons in the needle-trade unions, however, on which it was possible to draw some conclu-

sions with reference to the incidence of tuberculosis.

The survey was made with the cooperation of the Board of Health in supplying professional personnel. The WPA also participated. The Powers method of x-raying was used, and the x-ray films were read by three qualified men. Those persons having significant findings were studied in detail. When diagnosed as having tuberculosis, they were sent either to the family physician, the Union Health Center, or a clinic. There was no conference with management, but only with the unions. The health educational material was lent or given to the unions for adaptation.

Females predominated in this group, constituting about 75% of the total number, and whites also predominated. The high family wage level in this series was found to be $1500. There is considerable variation in foreign-born in the different groups from 84 to 32%.

Tabulations were used with reference to sex, age grouping, and race, as to active and arrested tuberculosis, and also as to primary tuberculosis. For details regarding these, reference should be made to the full proceedings to be published by the National Tuberculosis Association.

There is little evidence as to occupational influence in this survey in the needle-trades. Working conditions and wage scales have been greatly improved. It has now been decided to re-x-ray the two unions studied in 1939.

The cost of the survey is of course of great importance —this was done at approximately $1.75 for each examination in the survey, and the cost for each clinically significant case was $146.00.

It is believed that these surveys have established the importance of case-finding in industrial groups and that effective methods for this work have now been established. The full cooperation of all agencies involved will help to make an "all-out" campaign.

DR. EDWARDS' presentation was discussed by DRS. GARDNER and SAMPSON, and MR. CUMMINGS.

DR. HAYNES HAROLD FELLOWS spoke on the "Incidence and Causation of Tuberculosis in Office Workers."

With regard to applications for employment, there are three or four thousand examinations made in a year, of which 80% are females of the age group of 18 to 20. The incidence of tuberculosis in this group remained fairly steady from 1917 to 1940, approximately 1.3%. In one year the incidence went up to 2.8% in examinations of people out of employment.

In the employed group, in 1928 an incidence of 1% of tuberculosis was found, and in 1940 an incidence of 0.1%. In 1928 about half the cases were clinically significant, whereas in 1940 about 13 out of the 14 cases found were clinically significant.

One of the striking things about this experience is that recurrence reaches an amazing figure, even under ideal conditions of treatment. This is in spite of the fact that practically all these persons go back to their original work. For instance, 20% of the minimal cases among females and 40% of the minimal cases among males recur in the first five years, while 55% of the advanced male cases and 33% of the advanced female cases recur within the first five years. Of course the diagnostic criteria of recurrence are the same as used in spotting the original minimals.

It is interesting to note what happens to these people after the diagnosis has been made, with reference to their returning to work. In the group five years after discovery, 82% of the minimals, 62% of the moderately advanced, and 44% of the advanced cases were at work; in the group 10 years after, 76% of the minimals, 50% of the moderately advanced, and 50% of the advanced were at work.

In conclusion, it can be stated that a really adequate follow-up system has been established, the system probably missing 1% of the cases. It is definitely stated that tuberculosis is a real factor in adult life. Family and other responsibilities make it more difficult to get the tuberculoss healed among adults than in youngsters. The most diagnostic symptom is chest pain, in this series. As to the epidemiology, cases were spotted in different parts of the office building and did not occur in the same locations.

DR. D. M. BRUMFIEL spoke on "Tuberculosis Incidence in Cement and Gypsum Workers."

At the 1939 Silicosis Symposium at Saranac Lake, it was stated that gypsum dust did not predispose to tuberculosis or tend to activate latent tuberculosis. The same statement may be made for exposure to cement dust, either raw or in the finished state.

Of 114 persons exposed to gypsum dust, there were found no active or clinically significant cases; adding, however, a group of 61 persons as observed by Riddell, making a group of 175 in all, there was an incidence of 0.57%.

In a group of 2278 cement workers, including all age groups, in 11 plants, located in nine states, there was an incidence of 0.18%.

As to other types of lesions, the healed primary complex of childhood was found in 21% of the gypsum workers and 21.3% of the cement workers. Old adult lesions were found among gypsum workers in 4.5% and in cement workers in 3.8%.

With respect to other types of respiratory diseases, there was no great incidence in any of the groups studied.

It is concluded, therefore, that there is neither a predisposition to tuberculosis nor a tendency to reactivate tuberculosis among gypsum and cement workers, based on proof of clinical observations, as well as animal experimentation regarding the inertness of these types of dust.

Thursday Morning, June 12

DR. ADELAIDE ROSS SMITH presented material on "Incidence of Tuberculosis among Grain Handlers."

This was a study in the Buffalo district with reference to the findings in 390 grain handlers, occupied in transferring grain from boats to elevators. The work was done by bucket conveyors and shovels and scoops; sometimes the men used these alone and sometimes they were used in combination. The working conditions showed a lot of visible dust. No respirators were used, but the eyes were protected by silk stockings. The weighmen were exposed to the most visible dust in the elevators. Insecticides, such as carbon disulphide or carbon tetrachloride, were sprayed on the grain.

It was believed that an allergic action would be one of the most likely results of this exposure, arising from sensitivity to dust, rust, and smut. Common experiences showed that irritation was produced by fine grain hairs of wheat, barley, oats and rye and that there was also a possibility of fungus infestation.

The present study was done at the request of the grain handlers' union and a mobile unit was used. There were 254 scoopers and 156 elevator men. Of the group surveyed, 75% were 40 years of age and upward and 70% of the men had been employed 15 years or more.

Normal chests on physical examination were found in 78% of the group. In chest x-rays of the 390 persons, 79.7% were negative; 3.5% showed increased linear fibrosis; 1.7% showed non-specific infection; 12.5% showed healed tuberculosis (of which 10.2% showed primary complex); and 2.5% showed active tuberculosis.

There were 10 cases of clinically significant tuberculosis, occurring mostly among the scoopers, these people worked long hours, are unemployed in the winter, and are addicted to alcohol.

Since 1934 the union has had death records, showing 32 deaths in the period investigated; of these 28% were due to respiratory disease, among which were 10 pulmonary cases, (broncho-pneumonia four, and tuberculosis two).

In summary, it was stated that in clinical investigation of the incidence of respiratory disease, history and examination showed increased rates for fibrosis, non-specific infection and clinically significant tuberculosis. Wheat is the grain most often blamed.

In the discussion of DR. SMITH'S paper, DR. GARDNER and MR. CUMMINGS stated that there probably was not a great deal of tuberculosis in the elevator groups.

DR. A. G. KAMMER presented material with respect to "Iron and Steel Workers," stating in the beginning that there were two factors to be considered in this study, hard physical labor, and hot atmospheres.

In 15,000 men examined over a period of five years, 662 cases of tuberculosis were discovered. The principal procedures used in this survey were a routine physical examination, x-ray films of the chest and sedimentation rate. The incidence in applicants for employment was 6.2%, and the incidence for employees was 3.7%.

With respect to environmental conditions and occupations, three of the former were considered with reference to temperature (hot, modified or housed, outside jobs); as to types of work, there were three—hard work, moderately hard work, and light work.

The mean number of job-years for all types of occupations was about 10.

The disposition of 644 cases was as follows: 79.4% continued to work; 1.7% were transferred; 4.2% quit for treatment; 10.7% were rejected, and 4% were accepted for employment.

With reference to age grouping, there was shown a tendency to an increased incidence with increased age; there was also a tendency to take workers off hot jobs and a definite tendency to take workers off hard physical work. As far as influences of hot work are concerned, the figures seem to show less of an unfavorable course among the hot workers but a tendency by the examiners to permit continuance on outside work. As to the influence of physical effort, there was a clear indication of the examiners to let light workers remain on their jobs.

In a follow-up of 316 cases, there was an average of about three visits each, x-ray films of the chest averaging about two to each person, and a duration of follow-up averaging approximately 1.98 years.

This presentation was discussed by DRS. BECKER, SAMPSON, SANDER, EDWARDS, and MR. CUMMINGS.

DR. LEONARD GREENBURG presented material with reference to "Experience with Foundrymen."

In making certain statements in this presentation, it may be assumed that foundry employees come from an average group with an average incidence of tuberculosis.

There are several possibilities to be considered: added infection; the breaking down and activation of previous infection because of hard work; and the occurrence of a breakdown because of exposure to dust or other irritants.

We may proceed on the basis of the death rates, on the basis of case rates, or on a cross-sectional study made at a stated time.

It must be emphasized that there is difficulty in the diagnosis of infection in the face of well-developed silicosis.

Among foundrymen, molders and casters have a moderately high rate for tuberculosis (143.3), and among founders in general there is a high pneumonia rate (135.4).

Lantern slides were used to show a summary of previous studies of tuberculosis in foundries. There was a variation of 32% to 0.47% (the latter quoted from Sander's study); the 32% rate is open to question because the next highest rate was 6%. In Sander's study, the rate was low as observed (0.2% in the non-dusty occupations—nonfibrotic changes 0.5% — fibrotic changes 0.7% — and silicosis 3%).

In the New York study, there was a low incidence of tuberculosis (0.7%), and also it was noted that the rate was higher in silicotics (1.0%). The incidence increases as the years of employment increase.

Two important questions occurred to the speaker: Does tuberculosis predispose to silicosis or increase the incidence of silicosis? Does silicosis predispose to tuberculosis?

In conclusion, the speaker asked a number of questions and answered them:

1. How much tuberculosis is there without silicosis? (A normal amount).
2. Does this tuberculosis increase as the silicosis increases? (No, except as silicosis becomes far advanced).
3. Does silicosis activate tuberculosis? (Yes, late but not early—and even in the face of healed primary and adult lesions).
4. Does tuberculosis lay the groundwork for silicosis? (No, according to the foundry study).

Thursday Afternoon, June 12

DR. ALTON S. POPE continued the discussion of the "Incidence of Tuberculosis in Foundrymen."

There is an incidence of five times as much tuberculosis in groups of 25 years and over.

Foundry studies have shown that there is a much higher incidence of tuberculosis in silicotics as compared with non-silicotic foundrymen. In granite workers, the incidence is three times as great as the normal.

In the total foundry group, the mortality rate is 50% greater from tuberculosis than in the general population, whereas it is four times as high in the granite industry. It is, therefore, obvious that it is an important principle to exclude tuberculosis from the foundry.

The greater number of cases of silicosis and tuberculosis occur in men of 40 years of age or over.

Statistics exhibited by lantern slides showed a steady increase of cases of silico-tuberculosis, according to the increase of length of service. Silico-tuberculosis follows generally the same curve relative to dust exposure.

The speaker gave a demonstration of chest films and lantern slides of chest films, illustrating various types of cases. In conclusion, it was stated that the control of tuberculosis in the foundry lies in the prevention of silicosis and also in the prevention of infection.

MR. DONALD E. CUMMINGS presented material on the "Incidence of Tuberculosis in Hard-Rock Miners."

The first question raised was—who is a hard-rock miner? This is important, because some hard rocks contain little or no free silica.

Lantern slides were used to illustrate statistical data with reference to the incidence of tuberculosis.

A comparison was made of the figures of the U. S. registration area with the figures of the State of Oklahoma and with the figures from Ottawa county, Oklahoma, the latter reporting tremendously high rates. The highest rate ever reported was 6000 per 100,000 in the age group of 45 to 54.

Today, however, this situation does not obtain in these mining areas or in certain of the other well-developed mining communities.

As an example of a fairly normal distribution of cases, statistics were given on stereo films of white male miners in a group of 2,973 workers. In these, there were 25% normal x-ray films; 35% first-degree linear exaggeration; 17% second-degree linear exaggeration; 15% first-degree silicosis; 5% second-degree silicosis; and 0.3% third-degree silicosis.

In concluding, figures were presented to show that there is a tendency for the occurrence of more healed lesions in non-silicotic persons and contrariwise, and that the incidence of developing lesions rises directly with the age.

In summary, it was stated that free silica is the active factor in the production of silicosis and that there are individuals exposed to a silicosis hazard both with tuberculosis and without tuberculosis. Silicosis predisposes to the development of tuberculosis, which increases as the silicosis does. Dust exposure tends to stabilize the tuberculous lesion, as long as silicosis does not develop. A tuberculous individual upon acquiring silicosis runs a very chronic course. There may be community differences, but in most instances this is true.

DR. LOUIS BENSON discussed the subject of "Incidence of Tuberculosis in Granite vs. Marble Cutters."

Previous observations point to the fact that free silica is the disturbing element in dust. However, this is not true of the silicates with the excepton of asbestos. In fact, silicates when mixed with free silica, as in granite, have some inhibiting influence with respect to the action of free silica on the body.

In a review of the figures, it was found that there was 26 times the expected death rate from tuberculosis in granite and sandstone cutters. The figures suggest that there is considerably more tuberculosis than might be expected in marble workers.

Granite contains 27 to 35% quartz, whereas there is none in marble. In general, the dust concentrations varied

from 18 to 48 million particles of dust per cubic foot of air in granite work, with a maximum of 80 millions in drilling, while the dust exposure in marble work varied from two million to 26 million particles per cubic foot of air.

Figures taken from the State of Vermont experience during 1936-1939 based on death rates in 416 deaths, in those employed over 15 years, show a general death rate of 77 per 100,000. This general death rate is to be compared with the specific rates of various groups and locations: Washington county, 264; Rutland county (marble) 77; granite workers, 1835; slate workers, 213.

It should be stated that there was no mixture of workers, as from marble to granite or vice versa. Granite workers also had 53 times as much absence from tuberculosis as marble workers. It was found that the disability incidence for tuberculosis and pleurisy in marble workers was about the same as in general industrial population.

The incidence of tuberculosis rises by years of service and among those who are exposed to greater than 30 millions of particles per cubic foot of air for more than five years in granite dust.

The clinical picture of tuberculosis in marble workers follows the usual clinical course of what may be said to be the ordinary "garden variety" of tuberculosis, which is different from that which occurs in granite cutters.

In summary, it may be said that, owing to the siliceous dust exposure, tuberculosis is a definite factor in the lives of granite workers, but does not exist as an occupational factor in marble workers.

DR. BENSON'S presentation was discussed by DRS. GARDNER, GREENBURG, SANDER, BRUMFIEL and SAMPSON.

Friday Morning, June 13

DR. J. BURNS AMBERSON discussed the subject of the "Incidence of Tuberculosis in Medical Students, Nurses and Laboratory Workers."

Tests with old tuberculin among medical students at the University of Pennsylvania showed positive reactions in 70%, and 50 to 60% positive reactions among nurses at Bellevue Hospital.

The American Student Health Association figures during 1939-1940 showed in over 100,000 tested, a positive incidence of 25.4%. This is an overall incidence, and it should be noted that the rate runs higher in many isolated groups. There are, therefore, variables so great on account of geographical differences as to vitiate most statistics which have been available thus far.

However, there are fairly complete data on 885 nurses at Bellevue Hospital, with an average age of 19. Here there were 61 cases diagnosed as pulmonary tuberculosis and eight of these continued without trouble, still working at the present time. It appears that between 5 and 6% develop tuberculosis within 10 years (in the community, the rate in this age group is 1%). It is felt, therefore, that a rate of 0.5% may be a little high, but not much.

Of 53 nurses taking tuberculosis treatment, 30 contracted the disease while students, and 23 after graduation.

Whitney has stated that the death rate in physicians is approximately 27 to 28 per 100,000 persons per year.

The socio-economic status seems to be a powerful factor in the determination of the contraction of tuberculous infection. It is also emphasized that there are many different factors responsible for a breakdown.

Experience points to the fact that early treatment should be given in every possible instance, and patients kept under strict observation because of the tendency to serious spread. Careful use of the "infection technique" in sanatoriums and hospitals is strongly advised, and also attempts to discover tuberculosis in patients entering the hospital for whatever cause, or for observation.

In conclusion, especial stress was placed upon a case-finding program among hospital personnel. The Manteaux test should be given every six months with routine examination every year. The author prefers the chest x-ray film to fluoroscopy. Such a program has been responsible for the excellent record of no deaths in a nursing group during a period of 10 years.

DR. AMBERSON'S presentation was discussed by DRS. VOSBURGH, SAWYER, POPE and SMITH.

DR. WILLIAM SIEGEL opened the session on "Methods of Control" by discussing the subject "Case Finding Procedures."

The statistics all indicate that there is a definite trend toward the eradication of tuberculosis at the present time.

Twenty-five years ago there was no plan for case-finding and the main problem was the treatment of cases. The methods used today for case-finding were only used at that time for substantiation of diagnoses.

As to source of cases, work among children has been the most expensive and the least productive. This experience points to the adult group as having the possibility of being most productive.

In the present experience, the examination of contacts and the routine examination of non-contacts has been the most fruitful source of cases.

The New York State experience in examining certain industrial groups through a confidential arrangement showed that there was an incidence rate of 1.25% in a group of 8,833 employees. Interestingly enough, the incidence rate was the same in siliceous and non-siliceous dust exposures. Only 33% of the persons over 45 years of age had minimal disease.

In contrast to this, it was found that in mental institutions, the death rate was 12 times that of the general population, in the New York experience.

With respect to the methods used, the amount of time permits the use only of x-ray film, but the problem of cost still exists. Fluoroscopy is the least expensive, but there are other objections in the experience under discussion.

There are three types of methods in use: (1) 14x17 paper rolls; (2) 4x5 photographs of the fluoroscopic image; and (3) the 35 mm. films. Of the latter methods, it is concluded that the 4x5 was the best because it showed an efficiency of 98.3% as against an efficiency of 91% in the 35 mm. films.

In conclusion, it was stated that satisfactory methods involve an x-ray of the chest and examination of all contacts at least once, and the same procedures for all non-contacts who have chest symptoms.

DR. W. A. SAWYER spoke on "Administrative Procedures within the Plant."

In discussing this subject, it is well to realize that we are dealing with individuals and with a disease where people take on peculiar mental attitudes.

In putting through a program of tuberculosis control in industry, it is vital to secure the interest and enthusiasm of the industrial executives.

The speaker felt that industry has an obligation in this respect and can also assist the community officials, and, furthermore, that there is more than a dollar-and-cents basis on which to proceed.

As an example of what has been done, in this industry stereo x-ray films of the chest are routine on all pre-employment examinations and are developed before the applicant leaves the examining office. If there is any question about the findings, the applicant is asked to return the next day for consultation, after the films have completely dried. Any follow-up which is necessary is done on a flat film except in suspicious cases.

The record system was described, involving a follow-up on a tickler file which is taken care of by one person. The nomenclature of the National Tuberculosis Association is used in the records.

The policy of acceptance involves employing minimal, early and even moderately advanced types of the disease, according to the occupation, age, and other important factors, which are always taken into consideration.

It is important in such a program to have close supervision, which can be well done in an industrial medical department of this kind.

Periodic films of the chest are taken in the age group of 18 to 25 one year after a negative film on the pre-employment examination; every two years on the age group 26 to 30, and every three years on those 30 and over.

A visiting nursing service is provided.

Any employee complaining of chest symptoms is sent for a film of the chest, and on the tickler file the re-check routine date is moved up.

Cases are reported to the Health Department and followed up by nurses, through the attending physician.

As to cost, films, stationery, equipment, salaries and other expenses make the taking of each x-ray film cost $1.50. The cost of the whole program is $10,500 yearly.

Incidentally, the case cost to the community for tuberculosis cases is $3218.00, as shown in a survey made several years ago.

As to rates, in 1931 the rate in this industrial group was 2.3 per thousand and in 1940 it was 0.2 per thousand.

DR. SAWYER'S presentation was discussed by DRS. VOSBURGH, GARDNER, NEWCOMB and KAMMER.

Friday Afternoon, June 13

DR. LEVERETT D. BRISTOL spoke on "Public Health Relationships."

The control of tuberculosis is really a public health problem with the objective of finding cases and instituting proper treatment.

The primary purpose in all of these programs is to seek out the individuals, rather than wait for them to come to the physician.

Health education must be really at the forefront of any campaign which is successful in controlling and preventing tuberculosis. As comparisons, health classes and articles in house organs were mentioned. Health supervision articles are also sent to supervisors.

As an important point, it seems wise to consider a transfer of interest in the hygiene of work (40 hours) to the hygiene of leisure (51 hours).

It seems advisable to attack and concentrate on backward communities. As an illustration, the rate was 71.2 per 100,000 in Cattaraugus county in 1922 and fairly stationary at that time. In 1929, after a demonstration and health program, the rate was reduced to 17.9.

The program must be a broad health program instead of one concentrating on tuberculosis alone; if such a principle is followed, tuberculosis should be only a minor cause of death by 1960.

It is much too early to say what effect the present war will have on tuberculosis incidence. However, in the past war, there was considerable increase among women munitions workers. In the present war, there is overcrowding, and poor sanitation conditions, and these must be considered a potential factor of the increase in tuberculosis.

The question naturally arises as to what small industries can do. Recent developments indicate that the appraisal plan for health programs submitted to A. P. H. A. in 1932, revised by the National Industrial Conference Board in 1938, may be adapted to use for smaller industries.

DR. BRISTOL'S presentation was discussed by DR. NEWCOMB, who stated that he believed that there should be more money for public health education and less appropriated for statisticians.

MR. HENRY D. SAYER completed the material presented under the general subject of "Methods of Control," talking on the "Viewpoint of the Insurance Carrier on Tuberculosis in Industry."

This problem is of concern to insurance carriers because of its broad economic aspects, and because of the imposition of legal liability in certain jurisdictons.

A number of case reports were given to show that awards were made in cases which had rather doubtful origin as to employment factors. As an example of the kind of case mentioned, an employee was bitten by a mosquito on the finger, a cold abscess formed, metastasized to the lung, causing death from tuberculosis. Award was made which was sustained by a higher court.

With respect to the subject of occupational diseases, more than one-half the states are without statutory provisions. An occupational disease is hard to define—we are dealing with two words, one of which is medical. There are two schools of thought on the question—that an occupational disease results from a specific hazard in an occupation to which the general public is not exposed; the other school of thought believes an occupational disease is one which occurs in industry.

Various inconsistencies in legal provisions and decisions were described and illustrated. These emphasize the importance of thorough preparation and also the high cost of legislation and litigation. They also served to show that in different jurisdictions there were highly varying opinions, even among the higher courts. Among the famous cases mentioned was that of *Bishop* in New York, *Goldberg* in New York, and *Madeo* v. *Dibner* in Connecticut.

Referring to recent changes in the law, one instance was cited of a claim for silicosis, with the allegation of aggravation by smoke and fumes; an award was made under the general provisions of the law instead of the specific provisions. This award was later sustained. In another instance, the board found that tuberculosis was related to dust exposure, whether it was siliceous dust or not.

The speaker, therefore, suggested that tuberculosis might be considered as an occupational disease through specific provisions by adding a clause or a section to present existing laws. It is obvious that not every case could be compensated, but only those in which there was definite liability. It is believed that the compensation method might prove more satisfactory than resort to common law, and that there should be boards of medical experts provided and every attempt made to be fair to both employee and employer. It is furthermore believed that liability could not be fully assumed in such instances; that there should be a gradual approach as in the New York scheme.

The presentation of MR. SAYER was discussed by DRS. GARDNER, VOSBURGH, SAWYER, SAPPINGTON, AMBERSON, and MESSRS. CUMMINGS and BOWDITCH.

DR. LEROY U. GARDNER, in making his closing remarks, stated that the Symposium had accomplished one of its major purposes—to clarify the limitations of our present knowledge.

It is clear that there cannot be tuberculosis without the tubercle bacillus—that the source of the bacilli is almost always individual.

Most clinically significant is the re-infection type. There is a difference of opinion as to when infection occurs. There is a rising incidence of tuberculosis with advancing age, the bulk of which occurs in the group 15 to 30. There is one case per 2000 persons of new infections each year.

Except for certain exceptions, breakdowns are not due to environmental factors.

The standard of living is the main environmental factor. Of industrial exposures, free silica is the only one accepted without challenge.

Trauma may reactivate a previous tuberculosis and often serves to point out a pre-existing focus.

Of the dusts, only high free silica dust offers a change in the incidence of tuberculosis.

Infection is not necessary to develop silicosis, but favors its development.

In conclusion, the control procedures are necessarily education and prevention measures.

Tuberculosis and Its Allied Conditions

—As Commonly Seen in Our Industrial Population—

C. HOWARD MARCY, M.D.,
Director, Tuberculosis League Hospital, Pittsburgh

IN the past 35 years the death rate from tuberculosis in the general population of the United States has declined from 200 per 100,000 to 45 per 100,000. The disease that formerly ranked first as a cause of death is now in seventh place.

Presented at the Twenty-Sixth Annual Meeting of the AMERICAN ASSOCIATION OF INDUSTRIAL PHYSICIANS AND SURGEONS, Pittsburgh, May 7, 1941.

In spite of this notable achievement, tuberculosis continues to be one of the chief causes of premature death, chronic invalidism and social dependence. It is still a pandemic infection for which we have discovered no specific curative or preventive measures. The reduction in mortality cannot be attributed to any single method of approach, but is due to many correlated factors. Higher standards of medical practice, development of public health organizations, increased hospital facilities, improved working conditions and better housing have had important parts. New techniques, based on proved methods of public health practice, are constantly being devised, but as the death rate from the disease declines, continued reduction becomes more difficult. In the future, we must not only utilize the proved methods of the past but we should look to a more specific approach, based on present-day knowledge. While the disease recognizes no geographic boundaries, no age, race or economic status, certain reservoirs of infection become apparent with the general lowering of the death rate.

Increased attention is being given to the influence of industry on tuberculosis. Certain factors connected with the occupation tend to propagate the disease. A statistical analysis of workers shows the tuberculosis death rate in unskilled and semi-skilled labor to be above the average for the normal population. A study of the tuberculosis death rate in a large number of gainfully occupied males between the ages of 15 and 64 reveals that tuberculosis mortality in the unskilled and semi-skilled workers is approximately 2½ times that in the general population. Statistically, occupation would appear to be a factor in maintaining a high incidence of tuberculosis in certain groups.

Before condemning industry for this condition, a careful analysis of the causes of tuberculosis must be considered. There has been a great deal of confusion in terms when discussing tuberculosis arising out of employment. We cannot classify tuberculosis as an occupational disease, because of the nature of its etiology. An occupational disease must arise out of the occupation per se. Tuberculosis is an infectious disease caused by a definite germ, the tubercle bacillus. It cannot be present until this germ finds its way into the body's tissues. The infection is, in most instances, transmitted from the sick to the well. Regardless of occupation, it is impossible to have tuberculosis unless the seeds of the disease are implanted in the body. Tuberculous infection may exist in the body in a harmless, dormant way, or it may result in a serious, progressive type of disease, causing disability and death. It is a recognized fact that external influences that lower body resistance may cause a dormant infection to become active. These influences may arise from conditions of work, but on the other hand they may be due to circumstances that are not directly related to occupation. Such factors refer to illnesses of various kinds, over-crowded and unsanitary living conditions, improper diet, exposure to extremes of temperature, injury, dissipation and the constant inhalation of irritating substances. All human beings are susceptible to tuberculosis but the disease is found most frequently where unfavorable living and working conditions are present. In the eastern part of the United States, approximately 75% of the adults have already received some infection, as demonstrated by the tuberculin test. The vast majority of this group never become clinically ill, while a few eventually develop manifest disease. A statistical analysis by occupation of individuals who become ill with the disease, when compared with general figures, would indicate that in some laboring classes there is an increased hazard. It is not uncommon to hear that the incidence of tuberculosis in industry is about 2%, which is somewhat above the percentage found in the general population. What then are the factors responsible for this increase over the general incidence of the disease? Let us consider the situation from the standpoint of industry, keeping in mind, however, that conditions outside of employment have an important bearing on the problem. In other words, we must determine if it is what happens to the individual during the eight hours he is employed or if it is the way he utilizes the 16 hours when he is away from the plant that causes his tuberculosis.

An important consideration is the environment from which persons seeking employment are recruited. Unskilled labor is, to a large extent, obtained from localities of low economic standing. Tuberculosis thrives in such districts where overcrowding, bad living conditions and restricted diets are prevalent. It stands to reason, therefore, that individuals applying for work from these districts will have a higher incidence of the disease prior to their acceptance for work.

Studies made in Pittsburgh on the relation of tuberculosis mortality to economic and environmental status reveal the chances for tuberculosis to be approximately 3½ times greater in the poor man's family than in the well-to-do family. There is always a possibility of accepting persons for employment who are unfitted for work because of a pre-existing tuberculous infection. They may be unprepared to withstand fatigue, exposure and the various hazards to which they are subjected. They fail, in many instances, to seek medical advice when symptoms develop, because of economic conditions or the fear of losing their jobs. The result is that by the time their illness makes it impossible for them to continue with their work, the disease has advanced to a stage where treatment is of little avail. In the meantime, these employees have been in close contact with their associates, spreading germs of the disease to the uninfected. One infectious individual working in close contact with other employees may wreak havoc by spreading his infection to others. Three important factors in causing illness from tuberculosis become evident under these circumstances: *First*, the acceptance by industry of the sick or potentially sick individual for employment; *second*, the spread of the disease to his associates; and *third*, the environmental influences that have the capac-

ity to activate infection already present by putting the body under too great physiological strain.

IN TRADES in which there is an exposure to dust containing free silica, we find a very high incidence of tuberculosis. Silica dust in sufficient concentrations over a period of time causes a disseminated fibrosis of the lungs known as silicosis. Silicosis in itself is capable of causing disability, and it is definitely an occupational disease. A great many investigators have associated silicosis with the occurrence of pulmonary tuberculosis, and in the literature of this country there are many positive assertions concerning the frequent occurrence of tuberculosis with silicosis. It is an established fact that many of the silicotics die eventually from tuberculosis. It would appear that there is some relationship between the two diseases but the exact nature of this relationship is not known. We are constantly confronted with the problem of industrial responsibility for tuberculosis patients where evidence of silica is present but the disability is obviously due to tuberculosis. These so-called silico-tuberculosis cases are the basis for much confusion in our compensation courts. From a purely medical standpoint, it is impossible to state with any authority, in many instances, whether or not the silica present in the lungs is responsible for the progression of the tuberculous infection. When the disability is definitely due to changes caused by the silica dust, there can be no doubt about the industrial responsibility, but when tuberculosis complicates the situation, the question quite naturally arises as to whether that individual would have suffered from tuberculosis regardless of the silica in his lungs. This question must be raised because of the fact that in considering the tuberculosis problem as a whole, the role of silica is relatively minor. Then again, the fact that serious tuberculosis so frequently complicates silicosis makes it impossible to eliminate it as an etiological factor. Tuberculosis will not develop in a silicotic lung without the presence of tubercle bacilli, received before or after coming in contact with silica dust. In light of our present knowledge, we must consider the two diseases incompatible.

From the time of the establishment of compensation laws, the problem of the relationship of trauma to tuberculosis has been an important medicolegal topic. The subject is important from the standpoints of both the employee and the employer. The relationship of trauma to tuberculosis must always be an indirect one, for again we are confronted with the fact that tuberculosis has a specific etiology, the tubercle bacillus, and therefore trauma without the presence of the disease germ cannot produce tuberculosis. There is medical evidence to support the theory that trauma of sufficient degree, either by direct injury to the body tissue or because of lowered resistance resulting from serious injury, may reactivate a previously existent, dormant tuberculosis or cause more rapid progression of a previously existing active tuberculosis. To determine this relationship is not an easy matter. Human resistance to infection is an unmeasurable quantity in tuberculosis, a condition of which we know comparatively little. The onset and development of tuberculosis are so insidious that it is not uncommon for a person to work continuously for a considerable time without suspecting the presence of the infection. He may first become aware of the disease following an injury of one kind or another, and it is only natural that he will attribute his disability to the trauma.

It is frequently difficult to give a fair opinion as to the actual influence of the injury on the subsequent course of tuberculosis. In those cases where the train of disabling symptoms of the disease follow directly or shortly after the injury in a previously well individual, there should be comparatively little confusion. In other cases, where the tuberculosis does not manifest itself until some time after the accident, it is much more difficult to determine whether or not a relationship exists between the trauma and the activation of the disease. The severity of the accident as well as the length of time elapsing between the injury and the appearance of tuberculous disease are important considerations. Unfortunately, we do not have a satisfactory standard with which these factors can be measured. There is a wide divergence between those cases with direct injury to the lung followed by immediate respiratory symptoms, and injuries causing long drawn out debilitating illnesses finally terminating in tuberculosis. In other instances, it is not possible to say the disease was not influenced by the injury. The vague factor of lowered resistance is a spendid point of controversy for legal manipulating. The main point of the problem is in knowing the physical status of the employee's lungs at the time of injury. The practice of x-raying the chests of all employees before accepting them for work gives a base line for the solution of the effect of trauma on tuberculosis if the question of responsibility arises later. An x-ray of the chest at the time of accident, or within a few days, will show the presence of existing pathology, and subsequent development can then be easily followed. Too many times expensive litigation results from the diagnosis of a tuberculous infection that is recognized subsequent to a comparatively trivial accident, when the expenditure of a few dollars for an x-ray picture at the time of the accident would have given an indisputable basis for a fair opinion of employer responsibility.

INDUSTRIAL poisoning in certain instances is apparently capable of activating pulmonary tuberculosis. Obnoxious gases and vapors can produce inflammatory changes in the respiratory tract. If these changes are sufficiently severe and occur in the vicinity of a pre-existing tuberculous infection, it is quite possible that activation may occur. Here again, the amount of local damage done by the irritating agent and its effect on the individual's general health are important factors.

Some recent examples illustrate the problem. A

man, age 50, had worked as an electrician for an electrical concern for many years. He had an excellent work record and no history of significant past illness. The company, however, had no medical information about him at the time of employment or in subsequent years of service. In fact, he had lost but very little work from sickness over a period of years. He reported for work as usual and during the day picked up an unusually heavy electric motor and placed it on a work bench. Immediately following this exertion, he began to cough, and expectorated a considerable quantity of bright red blood. Examination of his chest revealed a moderately advanced fibroid type of pulmonary tuberculosis. The hemorrhage resulted in a bronchogenic spread of the disease and he died a few weeks later. The case went to court on the grounds of death due to tuberculosis, aggravated by pulmonary hemorrhage that was caused by undue exertion while the man was employed. The verdict was given in favor of the claimant.

A man, 35 years of age, was employed as a fireman for a power company. He worked for a number of years with a good record and no history of significant previous illness. One of his duties was to clean the clinkers from the fire boxes of the boilers. In doing this he used a crow-bar and had to exert considerable force. On the day of the alleged accident the bar stuck and required a great deal of physical effort to free it. Shortly after this exertion he had a pulmonary hemorrhage. Examination revealed a small apical lesion of tuberculosis, which appeared to be well fibrosed. He filed suit on the basis of tuberculosis aggravated by the incident requiring unusual physical exertion. He was awarded disability.

A man, 40 years of age, was working in a chemical plant when a nearby fellow workman dropped a retort containing chlorine on the floor. The fumes caused the patient to have a violent paroxysm of coughing, which was almost immediately followed by a frank pulmonary hemorrhage. Subsequent examination revealed the presence of pulmonary tuberculosis. He gave no history of previous illness. He filed suit and was awarded compensation on the basis of aggravation of his disease caused by inhalation of irritating fumes.

These cases are typical of a number of others that have recently come under our observation. They are important, not only from a medicolegal standpoint, but also because of their possible effect on rehabilitation programs for tuberculosis patients. Legally, the court decisions might be considered just. The unusual circumstance, in all probability, precipitated the hemorrhage in each case. The fact remains, however, that tuberculosis was pre-existing in the individual before the alleged accident. The claimant was fortunate that the hemorrhage occurred while at work, as it would undoubtedly have happened sooner or later.

It seems rather unfair to place the entire responsibility of such occurrences on the employers. The most important point, however, is the effect these cases will have on the future employment of persons with arrested tuberculosis. Thousands of such individuals are discharged each year from tuberculosis hospitals throughout the country. Many of them are quite capable of returning to gainful employment. Industry might use them to advantage in the present emergency, but is hesitant to accept them for employment because of the danger of becoming involved in damage suits, based on incidents beyond its control. As a result, persons are often refused employment when tuberculosis is known to exist, even when the disease is inactive and the applicant clinically well. Many firms require each person applying for work to have an x-ray examination made of his chest before he is accepted for employment. This precaution is a decided step forward in the general program for the control of tuberculosis. The employer is thereby protected, and infectious patients are prevented from spreading the disease to their fellow workers. Also, by this practice, valuable information is obtained as to the ability of persons with latent pathology to work under conditions requiring sustained effort. As a case-finding procedure, it will uncover a certain amount of tuberculosis that otherwise would be undiagnosed. It is, however, going to make it increasingly difficult for a large group of persons to obtain employment until the problem of liability has been worked out in ways that will protect both the employer and the employee.

Conclusions

THERE are factors in certain types of industry that would seem to influence the incidence of tuberculosis.

2. Tuberculosis is not an occupational disease and the influence of occupation alone, with a few exceptions, is probably a comparatively minor part of the program as a whole. Factors pertaining to the hours spent outside of work are equally, if not more important.

3. The influence of industry on the propagation of the disease is two-fold: *first,* crowded and unsanitary working conditions provide an opportunity for spread of the infection from one person to another; *second,* lowered resistance caused by fatigue, exposure, certain types of trauma or direct injury to respiratory tissues by some abrasive dusts, may affect the subsequent course of a tuberculous infection.

4. Industry provides an excellent opportunity for tuberculosis case-finding in apparently healthy individuals through periodic x-ray examinations of employees.

5. Tuberculosis control measures, to be successful in industry, must include programs to provide proper living conditions, adequate medical and hospital care, satisfactory diets, recreation and health education.

6. A more liberal attitude of employers is needed to provide selected work for those who have arrested disease and are physically fit for limited gainful occupations.

7. Compensation laws should protect the employee, but at the same time should not make the employer liable for conditions beyond his control.

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The Specialist

WITH industrial practice now recognized as a specialty and industrial physicians and surgeons entitled to classification as specialists, it may be well to consider for a moment the scope and meaning of the term. Aside from the purely technical requirements which are necessary for this rating, it is commonly supposed that the specialist is a man who confines his efforts to the particular thing in which he specializes. The connotation is that he withdraws from the general field and concentrates on one phase of it, more or less to the exclusion of the others; that he restricts the range of his activities from the miscellaneous plural to the specific singular. There is enough of reality behind this usual acceptance of the idea that a man becomes a specialist by specializing to give it a pretty good basis of truth.

The specialist in industrial medicine, however, does not become the specialist quite that way. It is true that he turns from the general field of medicine and surgery to the special field of industrial medicine and surgery. This might appear to involve a limitation from the obviously wider to the apparently narrower. But, when he looks in the industrial direction, he finds that the field of his specialty is broader instead of narrower, that the limitation is more apparent than real. For the industrial field is only the general field increased in objective importance and subjective requirements because industry, the employer, has become the third party to the doctor-patient relation, which lays upon the outcome of his efforts as a specialist the double need to get his patient well *and* back at work—with the superimposed duty to see that, in so far as health is concerned, he remains both. Industrial practice means, therefore, the practice not only of industrial medicine, to cure, but also of industrial health, to prevent. This puts it "one up" on the general practice, where vastly more is known about sickness than about its absence, and several "up" on the specialty which confines itself, as it were, to one department of the need for cure.

The aim of the true specialist in any matter is to know all about it. It is a large order to know all about industrial practice. In detail:

"Industrial health is a broad term and obviously includes all methods and practices aimed at the supervision and maintenance of a high level of personal health among industrial workers. The complexity of the field is thus obvious, particularly when it is realized that any factor which may adversely affect health becomes a problem for concern and investigation. In the very beginning, it should be noted that the essence of industrial health lies in the *prevention* of trouble. This conception necessarily broadens the field of approach and application of industrial health procedures. A distinction should be made between the general practice of industrial health and the general practice of industrial medicine and surgery. This distinction has already been made in practice in most instances. By and large, the practice of industrial medicine and surgery is limited to the diagnosis and treatment of disease and injuries. This, of course, is entirely the responsibility of the physician, and, in most part, the physician is mainly occupied with curative procedures. There is, however, what is called preventive medicine in industry. This directly applies to industrial health work, and in it the physician comes into close cooperative contact with the employer, the employee, the research worker, the industrial hygienist, and the safety engineer, not to mention the insurance company, the lawyer, the director of personnel and labor and public relations, the nurse, the psychologist, and the psychiatrist."[1]

That, however, is only the beginning; the cooperative quality of this contact must be translated.

"The effective application of preventive medicine and surgery in industry rests squarely on intimate acquaintance with working conditions, processes, materials, and men. The physician obtains such knowledge only by thorough and regular inspection of the plant."[2]

Thus, while the theoretical concept of industrial practice as a specialty funnels it to a point of single-minded application, its actual realization as a specialty fans it out to the width of all specialties. This is not paradoxical, however, for both the apparency and the reality are absorbed in the altered point of view of the medical man who becomes the true industrial medical specialist.

1. C. O. SAPPINGTON, M.D., DR. P.H., in *Armour Engineering and Alumnus*, December, 1940. 2. *J.A.M.A.*, July 5, 1941.

This altered point of view is the result of ceasing to regard the individual human being as primarily a category of disease possibilities, important perhaps in clinical statistics, and looking upon him instead as a unit of productive efficiency, important certainly in the community economics, of which the national is only the aggregate.

The men who have made industrial medicine what it is began years ago with that point of view. They recognized it as a basic principle of their relations to their industrial patients. In a manner of speaking, this is somewhat the public health point of view, with the difference that public health thinks of the individual in terms of the mass, while industrial medicine does exactly the opposite.

THERE is a restrictive element in industrial medical practice in that the more it becomes a specialty, the less it involves treatment, excepting, of course, as to occupational diseases, and not necessarily all of them. The treatment of most of the ills and disabilities that affect the employee is a matter for the private practitioner. But here one of the most important aspects of industrial medicine as a specialty becomes apparent. The private practitioner has to wait for his patient to come to him; the industrial practitioner not only can go out and find his patient, but it is his duty to do so. He is a successful specialist in proportion as he becomes a successful case-finder. Every medical man who is now in industrial medicine realizes how true this is, particularly as to such things as tuberculosis, cardiovascular diseases, and syphilis. The industrial specialist finds them to prevent their subsequent interference with the individual's economic efficiency, which is practically inevitable unless they are found. Once discovered, he follows them, as nearly as may be, to the point of correction or at least to minimum ultimate disability.

Industrial medicine is not new. Strong men made it, and strong minds are guiding it. The need is not for more of it where it is, but instead for more men to apply it where it is not now being applied. The men who are in it must be aided, and eventually must be succeeded. The younger men who are coming into it, and will continue to come into it even after the present emergency, not only must bring to it the background of brains, education and personality that are so essential to success as private practitioners or specialists, but they must also bring to it the ability to think of the individual in terms of health as well as in terms of sickness, and to view his position as an efficient productive unit in the light of keeping him *healthy at his work*, as well as seeing to it that he is cured of his sickness at home.

In short, to paraphrase the words of the A.M.A. Council on Industrial Health above quoted, the medical man will succeed as a specialist in industrial practice in proportion as he most happily and effectively transfers the exercise of his diagnostic acumen from the bedside to the benchside.

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INDUSTRIAL HEALTH AND DISEASE

Metallic Poisons

JOHN M. McDONALD, M.D.,
Director, Bureau of Occupational Diseases,
Baltimore City Health Department

THE purpose of this lecture is to discuss some of the metallic poisons, the manner in which they cause sickness and the nature of the diseases which result from exposure to them.

Industrial poisoning differs from that ordinarily seen outside industry. The cases we ordinarily hear about are due to the taking of one large dose of bichloride or arsenic or Paris green or some other poisonous substance with the result that the patient becomes violently ill within a few minutes, that is, has an acute poisoning. In industry acute poisoning is uncommon.

Much more often we see the chronic type of poisoning. This is because the disease is due to the absorption of many small doses of toxic material over a relatively long time, weeks, months or years. Each of the doses is so small that, if taken by itself, no demonstrable evidence of harm would have resulted. But the small amounts of poison pile up in the body till a quantity has accumulated sufficient to cause the signs and symptoms of disease.

In ordinary life most poisons get into the body by being swallowed, that is to say, by *ingestion*. In industrial exposures poisons may enter the body by *ingestion* or they may be breathed in, that is to say, by *inhalation* or they may enter by *penetration* through the skin. It makes a difference whether the poison is ingested or is inhaled.

To appreciate this difference let us look at the body as a traffic engineer might do. The digestive system, that is mouth, gullet, stomach and bowels, is what the traffic engineer would call a "through street." If a small amount of poison is swallowed there is a good chance that it may pass through the digestive system and be passed out in the bowel movement without ever having been absorbed into the body at all, and we know that does happen often. Even if some of the poison is absorbed from the bowel and gets into the blood, that blood must pass through the liver. The liver has considerable power to neutralize poisons and to get rid of them by way of the bile. The liver might be called a "traffic officer." So the digestive system is a "through street" protected by a "traffic officer."

If we examine the respiratory system, nose, throat, windpipe and lungs we find that it is what the engineer would call a "blind street" or a "dead-end street." Any dust or fume or vapor that is breathed into the lungs can escape only by returning the way it has come. Some of this inhaled material may lodge on the back of the throat and be swallowed. If the dust is very fine some of it is breathed out again. A portion of the inhaled material remains in the lung. This portion is absorbed directly into the blood. The blood from the lungs goes to the heart and from there to every part of the body without having to go through the liver. So the respiratory system is a "blind street" with no traffic officer.

Furthermore, a workman may be very careful to avoid eating with dirty hands or doing anything else whereby

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he might be in danger of swallowing poison but he cannot avoid breathing while at work. It should be clear that small doses inhaled are much more apt to gain entrance to the body by inhalation than by ingestion. It should be clear that small doses inhaled are much more apt to cause disease than are similar doses which are ingested.

The ideal state of affairs would be to remove all traces of poisonous material from the air of the work place. In the present state of our knowledge that is not always possible even with heavy expense. Fortunately, it is also not necessary, for we know that the human body can deal with minute quantities of poison without any apparent harm resulting. Our present practice, therefore, is to establish what are known as threshold limits or permissible concentrations for each poisonous material. For instance, the permissible concentration for lead dust and fumes is set at 1.5 mgms. per 10 cubic metres of air because experience has shown that where concentrations do not exceed this limit, cases of lead poisoning do not occur. Ten cubic metres of air were chosen because that is sufficient air to supply a workman for an eight-hour period of heavy physical labor. Where the exposure is to a gas or vapor concentration, permissible concentrations are usually expressed as so many parts per million.

Lead

LEAD is a bluish grey metal, melting at 325-330 C. It is very heavy, soft, malleable and ductile. It protects itself from corrosion by the formation of a thin coating of grey oxide, and forms an elastic film when mixed with linseed oil.

The most important source of lead is the sulphide ore known as galena. Carbonate and sulphate ores are sometimes found. Often small amounts of silver, antimony and zinc are found with lead.

Most lead is obtained by smelting galena or other ores. Large amounts are obtained by the reclaiming of junk materials such as old storage battery plates. Smaller quantities are recovered from the dross and scrap which accumulate in plants where lead is melted or otherwise processed.

Lead forms alloys with many other metals. Antimony is often used to stiffen and harden lead. Large amounts of such alloys are used in the manufacture of storage battery grids, plumbing supplies, tanks for holding acids and occasionally for the roofs of buildings. Other alloys are solder, babbit metal, type metal, etc.

Lead forms a large number of compounds some of the commoner of which are:

Lead carbonate (white lead) is the base for many outdoor paints.

Lead chromate (chrome yellow) is a yellow pigment used in paints.

Red lead (minimum) is a red pigment often used in paints.

Litharge (lead monoxide) is used in making other lead compounds, in enamelling and in the manufacture of optical glass.

Lead sulphate is another white pigment.

Lead acetate (sugar of lead) is a mordant in dyeing. When mixed with potassium bichromate it forms chrome yellow.

Lead arsenate is a powerful insecticide capable of being produced cheaply.

Tetra-ethyl lead is an anti-knock fluid for use in gasoline.

Exposures to lead and its compounds are numerous in industry. It has been said that there are about 150 different industrial occupations which involve a possible lead exposure.

Following are the principal hazards:

1. In making storage batteries several occupations have a lead exposure. The mixers who make the paste to be applied to battery grids are exposed to the dust of the lead oxides used in the paste. The oxides are run into the mixer dry. The mix is then wetted with dilute acid. Bits of the mix fall to the floor and are ground into dust which may be raised by air currents. Some of the mix gets on hands or clothing.

The pasters apply the damp mix to the grids to make plates. The pasted plates go through rollers to dry the paste. As it dries small portions break off and fall to the floor or on the pasters' hands. The inspectors who examine the dried plates are also subject to some dust.

Assemblers put the dry plates together into groups by burning on straps. In this process the plates must be dry and a certain amount of dust is raised.

The reclaimers who melt the scrap from the moulding room, damaged plates and dross from various sources are sometimes required to work in very dusty air.

Generally speaking the grid moulders have little if any exposure. There is some dross from their pots, and a good deal of scrap lead may be lying around the floor. The lead-antimony alloy can easily be kept hot enough to flow readily without heating it to the point where lead fumes are given off. The melting pots are small and comparatively easy to ventilate.

Wet processes are used in most of the other occupations in the storage battery industry, consequently exposures are slight.

2. In the paint industry large amounts of lead are consumed in making paints intended for outdoor use.

The chief exposure is experienced by the men who open the containers of white lead, red lead, chrome yellow or whatever lead base or pigment is being used and measure suitable quantities of each for transfer to the mixing machines in which lead compounds are intimately mixed with linseed oil. Drops of paint may fall to the floor, be dried and ground underfoot, and the dust may be dispersed in the air.

3. In the application of paints one exposure occurs in the dry sanding of paint. If this operation is carried on indoors considerable dust may get into the air. Spray painting with lead paints may also be responsible for considerable exposure in closed spaces. When a painter uses dry lead pigments to mix his own colors he runs the risk of inhaling some lead. Nowadays most paints are bought ready mixed. The painter's clothing often becomes spattered with paint which dries and forms another source of poisoning. Frequently, paint is smeared on the painter's hands from which it may be transferred to his lunch or gum or tobacco and then swallowed.

It is a common belief among painters that lead is absorbed through the skin. It is possible that their belief has some foundation in fact but the amounts thus absorbed are probably very small. In any case this possibility should be kept in mind when we consider methods of prevention.

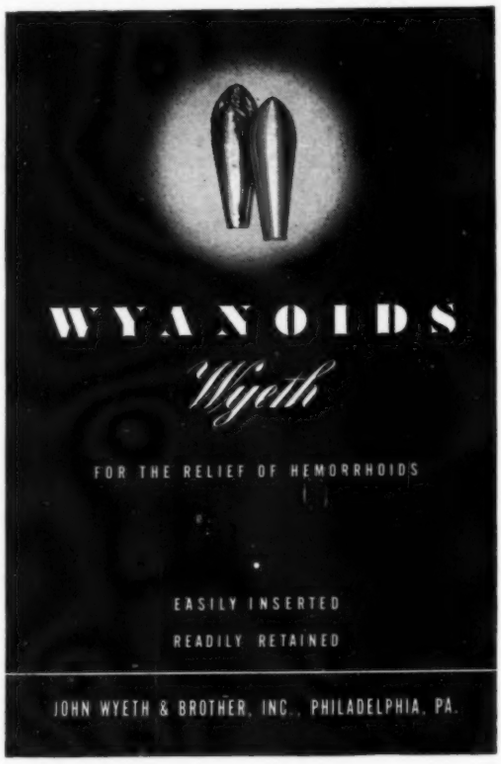
4. In enamelling such articles as bath tubs and in making pottery, lead compounds are sometimes used to provide a white base for the glazing. Powdered lead sulphate or oxide is part of the mixture that is dusted on the heated ware where it melts and adheres. The principal exposures here are among enamellers who apply the powdered enamel. In the pottery industry the dusty jobs are those of glaze makers, dippers and kiln placers.

5. In reclaiming lead from junk metals, such as old storage battery plates or auto radiators, the scrap metal is heated so that the lead will melt and collect in the bottom of the furnace where it can be run off into moulds. Since the metal is dry much dust is raised in its handling. In addition fumes may be given off from the furnace, so that furnace tenders frequently work in a serious exposure.

In another form of metal reclaiming, scrap steel is recovered by breaking up old ships. The metal is cut into conveniently-sized pieces by the use of a torch. Most of the ships broken up are old and have been repainted many times with a lead-containing paint. When this paint is heated by the torch, fumes of lead are formed in large amounts. Despite the fact this work is usually carried on in the open air, lead poisoning often arises from this source.

6. The chief lead insecticide is the arsenate. In making this product, the most serious exposure seems to occur in the packaging. Insecticides must be ground very fine and it is very easy for this dust to get into the air. Lead poisoning is fairly common as a result of this exposure.

7. In the printing industry there is a possible exposure from the pots of molten metal in the linotype or monotype machines. Some dross appears on the pots and must be removed occasionally. The plunger of the lead pump requires frequent cleaning. In practice, however, very few cases of poisoning arise from this source.



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The chief exposure in printing plants is in the operation of the kettle in which used type is remelted. A large amount of dross accumulates on this kettle. This dross must be removed and either pounced or sifted to remove large drops of lead. The operation is dusty and the exposure heavy though usually very short.

8. Welders and riveters in enclosed places working on steel that has been painted with red lead may heat the paint high enough to cause the formation of lead fumes. Several cases from such origins have been reported from New York and other cities.

9. In the rubber industry litharge is used as an accelerator, that is to speed up the process of vulcanization and make it uniform. The addition of lead compounds adds to the weight of the rubber product.

The principal exposure here is among the men who add the lead compounds to the mix of rubber and sulphur before vulcanization.

10. Exposures in the mining of lead ores are not considered particularly hazardous because the lead is in the form of the sulphide which is almost insoluble. Exposures do occur, however, in the smelting of the ore where large amounts of lead oxide dust are formed, and many fumes are present because of the high temperatures employed.

11. Serious exposures can occur to the makers of tetra-ethyl lead or to the cleaners of storage tanks in which ethyl gasoline has been kept for a long time. However, preventive measures against the dangers inherent in such operations have been brought to such a stage of perfection that the work can be done without injury to health so long as the known precautions are observed. So far as it is known no cases of lead poisoning have arisen from the use of leaded gasoline.

12. The manufacture of lead compounds such as white lead may be a source of serious exposures. White lead is usually made in one of two ways. In (a) the Dutch process, lead is melted and cast into buckles. The buckles are placed over pots of acetic acid layer upon layer to form a stack. This stack is built on tanbark and is allowed to stand for six to 12 weeks. When fermentation of the tanbark and the chemical action of the acetic acid are complete it will be found that most of the metallic lead has been converted into lead carbonate. The danger arises in removing this carbonate, which is a fine white powder. Large amounts of dust arise when the stack is torn down. (b) In the Carter process the operation is enclosed and is completed very rapidly so that exposures are easy to control.

Further exposures may arise in the grinding and sifting of white lead and in placing it in containers if the process is a dry one.

While this by no means exhausts the exposures to lead to be found in modern industrial processes, the main ones have been discussed. Note how often the exposure has been in the form of dust in the air. This is in accordance with our present belief that the great majority of cases of lead poisoning are caused by the inhalation of lead dust. It is true that lead does get into the body by ingestion and does thereby cause poisoning, but the greatest hazard is the presence of lead dust in the workroom air.

So far as penetration of the skin is concerned tetra-ethyl lead (not leaded gasoline) is probably the only lead compound which can pass through the skin in quantities large enough to cause poisoning. The people exposed to this hazard are so few and so well protected that tetra-ethyl lead poisoning is a very rare occurrence.

Lead poisoning is usually a chronic disease following upon prolonged exposure (months or years) to lead or its compounds. Its signs and symptoms are as follows: Pale pasty skin; drawn appearance; lead line may be present; irritability; colic; constipation; loss of appetite (especially for breakfast); pains in the muscles; marked weakness.

Any of these signs and symptoms may occur in other disease. Consequently, the examining physician cannot make a diagnosis on signs and symptoms alone. He must also know

the patient's occupational history and the exact nature of his exposure. In addition to the above facts, the doctor makes a careful examination of the patient's blood in which lead poisoning brings about certain changes. The blood usually will show a slight anemia and a peculiar stippled appearance in some of the red cells when properly stained. In many cases, the doctor has considerable difficulty in making a positive diagnosis. You may sometimes be in a position to supply valuable information about the patient's occupation and exposure that will assist the doctor in coming to a conclusion.

Chronic lead poisoning causes a disability of considerable length. Wisconsin figures show that the average lost time in lead poisoning cases was 66 days. In my experience, however, the milder cases required rest and treatment for at least six weeks before they were able to return to work.

Formerly some men suffering from lead poisoning were allowed to continue at work until they acquired lead palsy, a paralysis of the nerves and muscles usually in a forearm and hand. When a man has lead palsy, he loses the use of that hand almost entirely. Treatment takes months instead of weeks, and a large percentage of lead palsies turn out to be permanent disabilities. Nowadays industrial processes are much less dusty and ailing men are removed from exposure much sooner, so that cases of lead palsy are now extremely rare.

While we are speaking of disability, we should consider the question of deaths from lead poisoning contracted as a result of industrial exposure. In 1938 Wisconsin reported one death among 10 cases of lead poisoning. In 1940 in Baltimore, there were two deaths in 26 cases and in 1939, one death in 21 cases.

To sum it up it may be said that lead poisoning causes a large number of cases of temporary disability, a few permanent disabilities and an occasional death. It is by far the most common cause of disabilities due to exposures to metallic poisons in industry.

If the exposure is severe and prolonged practically all exposed persons will contract lead poisoning. Occasionally we find a man who shows no symptoms of illness although he has had a long exposure to a severe lead hazard which has caused sickness in others exposed to the same hazard. It is generally agreed that women and young persons are more susceptible to lead poisoning than men. There seems to be no racial difference in susceptibility.

The first principle in the treatment of lead poisoning is removal from exposure. Various drugs are then used to relieve the pain of lead colic, but the second principle is to open the bowels freely because the body gets rid of lead mainly by way of the bowel movements. Next the patient is usually put on a light soothing diet. It might occur to you that the patient should have some treatment to get rid of any lead which may have been deposited in his bones. Such treatment is sometimes given when the patient can be kept under close observation in a hospital, but there is some danger that too strenuous treatment might liberate too much lead at one time thereby bringing on colic. Generally it is better not to try to get rid of accumulated lead too rapidly. If they are removed from exposure most patients will rid themselves of absorbed lead without treatment.

The permissible concentration for lead is 1.5 mgms. per 10 cubic metres of air. In my experience no cases of poisoning occurred in workplaces where the lead content of the air was kept below that figure. Also that concentration was set some 10 years ago and there has been no suggestion that it should be altered.

It is estimated that 783,000 persons are industrially exposed to lead and its compounds in the U. S. A.

Mercury

MERCURY, or quicksilver, is the only metal which is liquid at ordinary temperatures. It vaporizes readily, boils at 360 C., and may form an oxide in contact with air. It is usually found as cinnabar, the sulphide. The chief deposits worked at present are in Spain and California.

Mercury is a silvery white metal with a bluish tinge. It is a good solvent for some other metals such as gold, silver, copper and zinc. The solutions thus formed are called amalgams.

Mercury is widely used in industry, a few of the commoner examples being: In scientific apparatus such as thermometers, in the fur and felt industry, in the manufacture of mercury fulminate, in making mercury vapor lamps, and in making vermilion (the alkaline sulphide used as a pigment). Amalgams are used in filling teeth, and many mercurial compounds find use in medicine as for example calomel, mercury bichloride and the different mercurial ointments. Almost all analytical laboratories use mercury in their work.

Exposures are numerous. They are found in the making of scientific instruments, in the processing of furs to make felt, in the manufacture of mercurial compounds, in the practice of dentistry, and in laboratory work, as well as in the refining of the metal itself.

Absorption is mainly by way of inhalation, but it should be remembered that mercury can penetrate the skin. Either vapors or dusts may be inhaled.

Mercury forms two types of compounds, mercurous and mercuric. The former are almost insoluble and hence are not considered so poisonous as the latter.

The disease caused by mercury is a chronic poisoning. The signs and symptoms are as follows: Metallic taste and salivation; inflammation of the gums with fetid breath and discharge; loss of appetite and attacks of diarrhea; blackening of teeth—later decay and loss of teeth; pallor and loss of weight; loss of muscular strength; morbid self-consciousness, anxiety and embarrassment followed by melancholia and depression; muscular tremors worse when observed or under influence of alcohol; lack of control of muscles interfering with writing and speaking; Bright's disease of kidneys; interference with vision; irritation of the skin.

It is said that from 1 to 2% of cinnabar miners are affected by poisoning. The roasting of the ore has been safeguarded so that very few cases arise from this source.

A recent report of the U. S. Public Health Service shows that in making felt, 8% of exposed workers developed signs and symptoms of mercury poisoning.

Disability is marked and prolonged.

Exposures in the United States are estimated at nearly 33,000.

The permissible concentration is 0.1 mgm. per cubic metre.

Cadmium

CADMIUM is a silvery white malleable and ductile metal which takes a high polish. It is commonly found along with zinc ores. It is extracted from blue powder, the residue left after zinc ore has been smelted.

Cadmium has excellent rust-resisting properties which have led to its use in plating (only within the last 15 to 20 years). This metal has a low melting point, which accounts for its use in solders. The sulphide is a brilliant long-lasting yellow occasionally employed in making paints. Alkaline storage batteries and cadmium vapor lamps consume small amounts of cadmium.

The main exposure is in the treatment of blue powder, especially the smelting and the emptying of filter bags. So far as we know cadmium poisoning has occurred only when men are exposed to cadmium heated high enough to give off the oxide, CdO, in yellowish brown fumes.

Absorption is by inhalation of the fumes of the oxide.

Acute cadmium poisoning is the only type of poisoning described. The symptoms are: Dry sore throat; cough and chills; general weakness; shortness of breath; tightness of the chest.

The seriousness of this disease is best illustrated by the following abstracts from a paper noted in the list of references.

An acetylene torch burner was welding cadmium-plated levers on switch boxes. Yellowish brown fumes came off during the process. After three hours' work he had to stop because of symptoms resembling the onset of influenza. He became short of breath and his chest felt tight. He lost six days' time but made a complete recovery.

In another factory cadmium plated rivets were being annealed in an oil furnace the temperature of which was well above the melting point of cadmium. Dense yellow black fumes were given off for a period of one and one-half hours. All 14 men who were more or less exposed became ill with the above-mentioned symptoms and two of those men died from an acute inflammation of the lungs. The two who died were the operator of the furnace and the foreman of the room, both of whom stayed near the furnace during the operation. The other 12 men whose exposures were not so severe nor as prolonged all recovered though some men lost as much as 11 days' time.

In another case of cadmium poisoning reported from Ohio, the patient lost two weeks' time. A few scattered deaths are reported in the literature. In this connection it must be remembered that our experience with cadmium has been relatively short.

No information on susceptibility is available.

The permissible concentration is given as 0.1 mgms. per cubic metre.

Zinc

ZINC is a blue white brittle metal usually found as the sulfide in association with iron pyrites or copper, lead and cadmium ores. It melts at 420 C. It burns just under 1,000 C. giving off dense white fumes of ZnO, zinc oxide.

Zinc provides very good protection against rusting, hence it is used in galvanizing iron and steel. Mixed with copper it forms the alloy known as brass. The oxide, ZnO, is a white powder widely used in paints because of its good covering power. Zinc oxide has a wide use in medicine in making zinc ointment and calamine lotion.

Zinc is separated from its ores by smelting. Electrolytic methods of separation give an almost pure zinc.

The chief exposures are in smelting or alloy making where freshly formed ZnO is given off in fine white fumes.

The fumes are absorbed by inhalation.

As a result of inhaling the fumes of zinc oxide, an exposed workman may develop an acute disease known as metal fume fever, zinc chills, brass-founder's ague, or spelter shakes. The attack of illness comes on several hours after exposure. The patient feels tired, has pains in his muscles, a headache and mild shivering. His throat is dry and tickling. The chill increases and he feels as if he had a high fever. The headache becomes worse, his ears rings, he coughs a good deal and often is nauseated. The symptoms resemble the onset of influenza. The chill continues for an hour or so and disappears. Next day the patient may feel somewhat tired and weak. Lost time is rarely more than one day if any.

No ill effects seem to follow such chills. About 75% of workmen regularly exposed do not suffer from this disease, another 20% have chills occasionally and in the remainder they are frequent. New men or men returning after an absence are most often the victims. Chills occur only after exposure to fumes given off when zinc is heated to about 1,000 C.

Permissible concentrations have been given as 15 mgms. per cubic metre of air.

The number of persons exposed to zinc and its compounds is not known.

Manganese

MANGANESE is a hard grey brittle metal found as the dioxide in an ore called pyrolusite. Pyrolusite is very black. Before use the ore is ground up into a very fine powder, a dusty operation. Manganese compounds readily absorb and give up oxygen.

The addition of manganese hardens steel. The resulting alloy is known as ferromanganese. The dioxide is an important constituent of dry batteries. It decolorizes glass or colors it purple, depending on the amounts used. It is often employed as a drier in paints, and small amounts find a place in medicine as disinfectants.

The chief exposure comes in the plants where the ore is crushed. The ore is slightly deliquescent, so that it must be dried before crushing. After crushing the fine powder is bagged in tough paper sacks. Both crushing and bagging are very dusty operations unless properly exhausted.

Absorption is by inhalation of the finely divided powder.

Manganese poisoning is a chronic disease. Its symptoms are muscular stiffness and an inability to make muscles work together in unison. Patients fall when they walk backwards. They may have difficulty in talking, twitching of the muscles of the face, and a masked expression. They complain of drowsiness, weakness and muscular cramps. They may have emotional disturbances, as laughing or crying for no good reason.

In the report of a recent study, it is stated that no cases of manganese poisoning occurred in the employees of the plant studied so long as exposures were to less than 30 mgms. per cubic metre. However, the writers feel that 30 mgms. of manganese per cubic metre should not be considered a permissible concentration until proved by further studies on other plants.

Disability is believed to be permanent once the disease is well established. Some improvement may be expected if the ailment is caught in the early stages and the patient is removed from exposure.

No statistics are available on incidence or susceptibility. It is estimated that 23,000 persons are exposed to manganese in the U. S.

Arsenic

ARSENIC is a silver-grey metal whose ore, the sulphide, usually accompanies iron pyrites, copper, nickel, zinc and cobalt ores.

The commonest compound in industrial use is the trioxide, As_2O_3.

Arsenical compounds make good insecticides, e.g., lead arsenate and Paris green (copper aceto-arsenite). Some medicinal preparations contain arsenic, e.g., salvarsan. It is often mixed in anti-fouling paint intended to kill barnacles. It is a good decolorizer for glass.

The principal exposures are in the smelting of arsenic ores and in the manufacturing and packaging of insecticides.

The fine dust of arsenical compounds is absorbed by inhalation.

Arsenical poisoning seen in industry is usually chronic in character. The symptoms are general weakness, pain in the stomach and nausea, possibly some vomiting. The skin sweats excessively, it may become bronze colored and may peel off in fine flakes. Warts are common. If the exposure is continued nails and hair may fall out and the patient's voice becomes hoarse and he may have bronchitis. Numbness may appear in the extremities.

Treatment consists in removal from exposure, and laxatives to help elimination.

Disability is variable. The skin condition may persist for weeks or months. People vary greatly in their susceptibility to arsenic and some persons may develop a partial immunity.

No figures are available on incidence.

Permissible concentrations for arsenical compounds are generally set at 0.5 mgms. of As_2O_3 per cubic metre of air, but this standard should be considered as tentative at present.

Arsenic trichloride, $AsCl_3$, has been used as a war gas and is said to be very poisonous, but definite information as to its effects is lacking.

Another arsenical compound of some importance is arseniuretted hydrogen or arsine, AsH_3, a gas which may be given off when metals and acids come together, as in pickling operations, if either metal or acid contain traces of arsenic. This gas sometimes arises from submarine batteries or from impure ferrosilicon when wetted.

Arsine is absorbed by inhalation. It is a violent poison which destroys the blood. Immediate inhalation of oxygen is advised.

If the patient survives he is likely to have a long disability due to kidney disease.

No information is available as to susceptibility.

Permissible concentration for arsine is 1 p.p.m.

It has been estimated that 34,250 persons are exposed to arsenic and its compounds in the U. S.

Antimony

ANTIMONY is a grey metal usually found as the sulphide. Its ores often contain arsenic. It melts at 630 C., is resistant to corrosion, and has the property of expanding when it cools.

The commoner compounds and their uses are as follows:

The sulphide colors rubber goods red.

The sesquisulphide is used in making safety matches.

Various compounds are useful mordants.

Antimony itself is used in fireworks, but the chief use is in making alloys such as babbit metal, type metal and storage battery grids. Since it expands on cooling antimony gives sharp impressions from moulds, a property especially valuable in making type. It hardens lead, thus making stronger grids.

It must be remembered that arsenic is often a contaminant of antimony, consequently arsenic may be responsible for the symptoms observed. When lead and antimony are used together, the symptoms of lead poisoning may mask those of antimony poisoning, if any are present.

Antimony is a skin irritant. There is no agreement as to whether it is a true poison.

Information about incidence, disability and susceptibility is lacking. No permissible concentrations exist. Over 99,000 persons are exposed in the U. S.

Thallium

THALLIUM is found as the sulphide in association with ores of zinc, lead, iron, bismuth or platinum.

It is a silvery white metal, melting at 300 C. It is obtained by treating the residues left from the smelting of zinc pyrites.

Thallium carbonate gives a green color to fireworks and is also used to color glass in making imitation precious stones. The acetate is used to remove hair, and also as a rat poison for which purpose it is said to be four times as strong as arsenic.

The chief exposures are in the roasting of zinc residues and in manufacturing of fireworks, rat paste and tungsten lamps. Thallium compounds are absorbed by inhalation and accumulate in the body.

The symptoms of thallium poisoning are as follows: Mental excitement which soon disappears; pain, weakness and cramps in the lower limbs; falling of the hair; various digestive upsets may occur; blindness is the most serious symptom.

The disability from the blindness is permanent.

No statistics on incidence are available but cases are probably rare.

The treatment advised is removal from exposure and free elimination.

The number of exposed persons is not known.

No permissible concentrations have been suggested.

Selenium

SELENIUM is usually found in association with copper ores. It is a steel grey crystalline material with an odor like radishes. It boils at 690 C. When copper is refined by the electrolytic method selenium is deposited in the residue known as anode mud.

The outstanding property of selenium is that its electrical conductivity is increased in the presence of light and decreased in the absence of light.

Selenium is mainly used in the manufacture of photoelectric cells, but some small amounts are employed in glass making, principally to make the ruby red glass for railroad signals.

The chief industrial exposure is in the recovery of selenium from anode mud. Very few persons are exposed, as this is generally a laboratory procedure rather than an industrial process. In the heating of anode mud fumes of selenium oxides are given off.

Absorption is by inhalation.

The only patient affected by selenium that I have seen complained of a metallic taste, a dry mouth and a sore throat. His breath had a most distressing odor. He complained of abdominal discomfort especially after eating starchy foods. A high protein diet agreed much better. He was not disabled.

No data are available on susceptibility, disability or permissible concentrations.

Treatment is removal from exposure, elimination and protein diet.

It is estimated that about 4,000 persons are exposed in the U. S.

Phosphorus

PHOSPHORUS is a soft waxy metalloid with a garlic odor. In nature it is never found free but always in combinations such as phosphates. The bones of all animals contain large amounts of phosphates.

Phosphorus is obtained by treatment of phosphates or calcined bones with sulphuric acid. The acid phosphate thus obtained is heated with coke in a muffled furnace. Phosphorus distills off in the white (yellow) form. If white phosphorus is heated in the absence of oxygen it is changed to red phosphorus, an allotropic form which is generally considered to be harmless and is the form now commonly used.

White phosphorus ignites spontaneously in moist air at about 30 C. The burning gives rise to fumes of P_2O_5.

Phosphorus is used in making fertilizer, i.e., as a phosphate. Combined with sulphur it is employed in making safety matches. It is also used in making fireworks, smoke bombs and war gases as well as in the production of phosphor bronze, an alloy for bearings. Formerly it had some vogue as a rat poison.

The patient undergoes a long period of disability, terminating in a permanent disfigurement.

The practice of using white phosphorus was stopped by the imposition of a heavy tax on such matches. Red phosphorus is now employed.

Nothing is known about susceptibility. Cases are very rare. Exposures may be present in the manufacture of phosphorus itself or in fireworks plants. It has been suggested that phosphorus may be given off in the fertilizer industry when phosphate rock is treated with sulphuric acid, but no cases are known to have been attributed to this cause.

Chromium

THE chief ore containing chromium is Cr_2O_3 FeO, commonly called chromite. Chromium is a bluish white metal capable of taking a high polish which is strongly resistant to corrosion. It is very hard, with a high melting point, 1620 C.

The ore is smelted by being heated with an alkali, forming a soluble chromate. Other compounds are made from this chromate. By adding sulfuric acid, chromic acid is obtained. Other products are the chromates and bichromates of potassium, sodium and ammonium.

The chief uses are in plating (using chromic acid or the anhydride CrO_3), manufacture of lead chromate (an excellent yellow pigment), making stainless steel, chrome tanning of leather, textile dyeing and photo-engraving and photography.

Chromium the metal is not considered poisonous but there has been considerable discussion as to the toxicity of its compounds. At present the bulk of the evidence seems to show that chromium compounds are not poisons in industrial exposures. However, when chromic acid or the alkaline bichromates come in contact with the human skin, they can cause more or less severe irritations of the skin, sometimes going on to ulcer formation. If the same materials are inhaled they settle on the nasal septum where they may cause perforation. From 75 to 80% of those exposed to these substances are susceptible to perforations.

Prolonged disability may arise from chrome ulcers of the skin. It is somewhat doubtful whether or not a perforation of the septum is disabling, but it is a matter of record that compensation has been paid on that account in New Jersey.

The permissible concentration for chromic acid is generally given as 0.1 mgms. per cubic metre of air.

It has been calculated that more than 81,000 industrial employees are exposed to chromium and its compounds in the United States.

Radium

RADIUM has the property of giving off rays very similar to x-rays. Its chief use is in medicine where it is employed in the treatment of cancer. Industrially, it is used to activate zinc sulphide so that the resulting mixture will shine in the dark. This mixture is applied to the dials of instruments in airplanes used for night flying. Radium compounds may be absorbed by inhalation if in the form of dust, or, under certain conditions, they may be ingested.

Most of our information comes from the outbreak of radium poisoning which occurred in northern New Jersey some years ago. A number of women were painting watch dials with fine brushes using a radium mixture. They were in the habit of pointing the brushes with their lips. As a result a good deal of radium was ab-

—Continued on page 66

INDUSTRIAL HYGIENE SECTION

This Industrial Hygiene Section is published to promote sound thought upon and concerning industrial hygiene. To that end it will contain articles, discussions, news items, reports, digests, and other presentations, together with editorial comments. The editorial policy is to encourage frank discussion. On this basis contributions are invited.

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The Editorial Committee will exercise its best judgment in selecting for publication the material which presents most exactly the factors affecting industrial health and developments for control of potentially injurious exposures. The editors may not concur in opinions expressed by the authors but will endeavor to assure authenticity of fact.

The Science, the Law and the Economics of Industrial Health

Volume 2 OCTOBER, 1941 Section 4

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Conservation

—In National Defense—

DESPITE the myriad destructive elements being produced for defense of the nation, the ultimate purpose of these engines of war is conservation of our American way of living. It is accordingly a most logical corollary that, with national defense for conservation, there should be conservation in national defense.

Advanced industrial hygiene methods are going forward in step with defense activities. By the time this goes to press, medical and engineering studies will have been completed in 27 industrial military establishments throughout the country. These include all arsenals of the Ordnance Department, proving grounds and depots. The surveys are being conducted by industrial health teams consisting of trained field personnel of the Division of Industrial Health, National Institute of Health, together with representatives of the Army Medical Corps and the Ordnance Department. With such surveys, information is made available to the Surgeon-General of the Army concerning potential health hazards incident to the wide variety of operations. The extent of the hazards is evaluated and, where necessary, control measures are recommended.

The research staff of the National Institute of Health is available to study the effects of materials concerning which sufficient information may not be available. It is not anticipated that any such catastrophic occurrence will develop as in the last war, when 360 cases of toxic jaundice due to TNT were reported among British munition workers, with 96 deaths, but research is in progress at the National Institute of Health on the toxicology of trinitrotoluene to insure that any unsuspected deleterious effects will be avoided among the many persons exposed to the vapor and dust of this military explosive.

Not only are the military establishments to be included in this survey, but the health hazards in the government-owned, privately-operated defense plants have also been placed under the jurisdiction of the United States Public Health Service at the

request of the War Department. The studies of conditions affecting health in these plants will be undertaken in October as soon as the work in the government-operated plants has been completed.

Of a personnel of 106 persons in the National Division of Industrial Hygiene, 32 professional workers were engaged directly in field activities in the defense industries by early summer. This number has since been augmented and, in order to assure continuity of these services, a quarter of a million dollars has been made available to the National Industrial Hygiene Division in the 1942 fiscal year for surveys of defense industries alone.

The privately-owned and privately-operated plants of the country have by no means been outside the pale of effective industrial hygiene services. State bureaus of industrial hygiene have greatly increased their activities in this field. Private organizations have been extended to keep pace with the demands placed upon them. The Industrial Hygiene Foundation of America has added to its field staff engaged in plant surveys. The Committee on Healthful Working Conditions of the National Association of Manufacturers has held industrial health clinics in manufacturing centers and, in a report of a survey of 2,064 industrial establishments, has demonstrated the manyfold advantages of a health program.* The exhibit of a balance sheet showing, on the basis of actual figures obtained from operating concerns, that a health program saves the average 500-employee plant $5,611 net per year is indeed stimulating. In fact, this amount includes much more than the bare profit element—it incorporates a substantial conservation of material and man power.

The conservation divisions of the insurance companies, the industrial hygiene personnel of individual manufacturing concerns, private consultants, and the training facilities of a number of the universities are all working for the control of health hazards incident to modern industry.

Frantic effort to meet ambitious production schedules tends to sweep all caution before it. But with intelligent management, conservation of resources is recognized as an essential to maximum accomplishment. Most important of the country's resources are its people, and only through the conservation of their health can the maximum in national defense be attained.

*See INDUSTRIAL MEDICINE, September, 1941, pp. 388-397.

Industrial Hygiene Progress

—During the Past Year—

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INDUSTRIAL hygiene has been a live subject during the past year. With increasing emphasis on national defense, the importance of providing and maintaining healthful working conditions has received wider attention. Meticulous laboratory research and practical field investigation have broadened our knowledge of deleterious environmental factors and have pointed the way to more effective control measures.

Not only do we know how to handle potentially injurious conditions more capably, but it is also of real significance that more work is actually being done in the application of these control measures to industrial conditions throughout the country.

Dust

MOST spectacular of the progress in dust diseases, experimentation with aluminum continues to hold the limelight as a means of prevention and cure of silicosis. In an Arizona metal mine, bombs of aluminum powder are exploded in the headings when the shot is fired to cause admixture of the silica dust with approximately 1% aluminum dust. At another location a group of men who show pulmonary changes caused by silica dust are having their lungs dust daily with aluminum powder. Although it will be months before definite results are obtained, signs are already reported as far from discouraging. Investigators interested in these aluminum dust applications emphasize that its use is not to be recommended as a substitute for dust control.

Although it was early recognized that the 1% aluminum powder-siliceous dust mixture was far below the explosive range, research was reported during the year on the explosibility of silica-aluminum dust mixtures, important in view of the possibility of high local concentrations of aluminum dust. A silica dust percentage twice that of the aluminum dust was found to be sufficient to prevent explosion and, whereas an ounce of aluminum dust would presumably be effective in inhibition of silicosis in an air volume of 8,000 cubic feet, an ounce must be confined to only 25 cubic feet of clean air to be explosive.

Evidence was presented during 1940 indicating that silicosis is still very much with us as an occupational disease. In Ohio, it was reported that in less than the three years of its inclusion in the compensation law, 131 silicosis claims had been approved out of a total of 387 claims filed with 66 still pending. The foundry and the ceramics in-

Presented at the Second Annual Meeting of the AMERICAN INDUSTRIAL HYGIENE ASSOCIATION, Pittsburgh, May 8, 1941.

dustries contributed 90% of the claims awarded in that state. Figures released during 1941 continue to show this same trend.

Major rock tunnelling operations were in progress during the year. The dust and gas control measures in force at the New York aqueduct project were followed in drilling the seven tunnels of the Pennsylvania Turnpike. Periodic dust counts were made of tunnel air, as were tests for carbon monoxide after blasting. Methane tests were also made. Wet drilling was used throughout. Pre-employment physical examinations including chest x-rays were made to assure that workers were in good health. At the three rock tunnels on one water-power project in western North Carolina and two tunnels on a second such project in this area, similar precautions were followed. It was not being left to chance in 1940 that everything would be all right. State departments, insurance companies and contractors were being sure that everything was as it should be.

In South Africa, engineering and medical control have caused a new low record for silicosis cases, but there is a marked increase in the incidence rate with longer duration of service and also with more time spent in machine drilling.

Results of the operation of the New York State dust code for rock drilling were reported, together with the distribution of rock of various free silica percentages. Most drilling operations in this state are conducted in rock which averages either less than 10% free silica or appreciably more than this threshold percentage. In the former case, exposures up to 100 million particles per cubic foot of air are considered permissible but where the free silica averages more than 10%, dust control measures must keep the concentration to the more stringent 10 million particles limit. This mineralogical situation has appreciably assisted the administration of the code by reducing the number of difficult borderline cases.

Stone crushing plants have long sent their huge dust clouds into the air to be breathed by the plant operators and to cover the countryside. The effective dust control applied to the large crushed stone aggregate plant in the construction of TVA's Hiwassee Dam project was reported by L. P. Hatch and D. F. Shaw. Structural details of the exhaust ventilation system and results of determination of dust concentrations were given to serve as an excellent guide to other engineers confronted with similar problems.

Roofing granule plants constructed and placed in operation during the year in New Jersey and in Wisconsin incorporated dust control and dust collection. In Utah, a capable and complete study of dust conditions and their effects on the health of workers in bituminous coal mines, non-ferrous metal mines and non-ferrous metal smelters was reported. In North Carolina, similar studies were made of men exposed to mica, kaolin and pegmatite dusts — the latter being made up of mica, quartz and feldspar.

Experimentally, Gardner has increased his evidence that silica particles over 3 microns in size are physiologically insignificant. Tebbins concurred but went even further. On using dust fractions containing particles smaller than 3.3, 1.7, 1.0 and 0.6 microns, he found that particles in the 1.7 and 3.3 micron range caused no gross pathological changes, while the dust in the smaller ranges produces such changes. Miller continued his extensive study of the response of peritoneal tissue to industrial dusts and, with Sayers, reported results of 10 dusts causing absorptive reaction, 13 dusts causing a proliferative reaction and 46 dusts causing an inert reaction. The first and third groups were thus not productive of silicosis whereas dusts in the second group would cause silicosis on sufficient exposure. Every dust producing a proliferative reaction included free silica.

In the experimental study of dust in air, a new constant dust feeding device was devised by Williams and Battista. No striking developments were noted in dust determination procedures, although Williams presented a technique utilizing a blood-counting cell with an unorthodox 300 magnification microscopic system, and Ohleiser published a method using a similar cell but with the usual 100 magnification microscopic system which he and Lawrence had developed some years ago and have been using satisfactorily ever since.

The results of experience with the Bureau of Mines type midget impinger, the electric precipitator and methods of counting are usefully discussed by the American Public Health Association Committee on "Dust Procedures in Air Analysis," of which Bloomfield is Chairman. It was pointed out that the midget impinger, with its lower nozzle velocity of 12,000 feet per minute as against 22,000 feet per minute of the large impinger, is a practical instrument for the sampling of silica and siliceous mineral dusts, but is much less efficient than the large impinger for sampling fumes.

In the determination of quartz in dust, the application of x-ray diffraction methods is becoming more prominent. Berkelhamer has developed methods for preparation of the sample and has done sufficient work with the method to have recognized both its limitations and its advantages. Investigators at Pennsylvania State College have also carried on developmental work with this method. Berkelhamer upset accepted laws on rate of settling of dusts as a result of measurements made possible by the Leitz tyndallometer.

Lead

CONFLICTING conjectures have been advanced concerning the relative toxicity of lead and some of its common compounds. Fairhall has cleared up many of these uncertainties by a comprehensive research on the amount of lead absorbed into the body on exposure to these materials. Experiments were conducted with 500 guinea pigs, some of which ate the lead, others inhaled it, and still others received it through intraperitoneal injection. Lead arsenate, carbonate, monoxide and sulphate were somewhat more toxic than lead and other lead compounds when fed to the animals. On inhalation, lead carbonate

and lead monoxide were definitely more toxic than the other lead compounds. When injected into the peritoneum, lead and its compounds remained without appreciable absorption except for lead arsenate which produced rapid and definite evidences of absorption, due to the solubility of the arsenic portion of the compound. Generally, the lead compounds were found to be much more toxic when inhaled than when ingested or injected.

To obtain further data on effect of ingestion of known amounts of lead, Kehoe fed one human subject 2 milligrams of soluble lead daily for 13 months and a second human subject 1 milligram daily for 39 months. Neither showed any symptoms or blood changes indicative of injury. Lead excretion increased so that only a slight and almost negligible amount of this lead was retained in the body. Of especial interest from an industrial hygiene point of view, concentrations of lead in urine of 50 to 150 gamma and slightly more are compatible with normal health and well being of human adults. Also of interest, it was found through an extensive series of analyses and observations of freely chosen diet, that adults in various parts of the United States ingest with food and beverages from somewhat less than 0.10 milligrams to somewhat more than 2.00 milligrams of lead a day, with a mean value of a third of a milligram a day.

Nineteen Hundred Forty gave further evidence of industry's accomplishments in controlling its health hazards through modern, industrial hygiene methods. Published during the year was the report of the industrial hygiene sessions held at the annual convention of the National Battery Manufacturers' Association. This Association instigated the survey of its lead exposures which was recently made by the National Institute of Health. The report includes a summary of the results of this survey together with discussion of various phases of industrial hygiene in the lead battery industry.

The steel industry did not rest with control of the lead hazard within the steel plant when leaded steels were being produced — it went further and investigated the potential hazards to the users of such steel. Amounts of lead volatilized under such operations as machining, heat treating, forging, oxyacetylene cutting and arc welding were determined by Halley and Martin. Significant amounts of lead are released only when scale is produced or the steel is actually melted. Amounts of air which should be moved for reducing the lead disseminated into the air to safe limits are calculated for these several operations.

The lead exposures in the printing industry were determined by Ruf in a group of 14 Wisconsin plants, and 40 employees of these plants were examined for evidence of lead absorption by Belknap. The study showed that, with few exceptions, atmosphere lead concentrations were within safe limits but it was added that ordinary precautions were not to be considered unnecessary. To avoid dispersion of lead dust into the air, vacuum cleaners were recommended for cleaning type cases and floors. Physical examination and laboratory findings on the workers showed them to be in good health, the only evidence of lead absorption being the somewhat high average urinary lead excretion of 190 gammas per liter. Additional data are being developed on the subject of lead exposures in the printing industry during the present year.

Occupational lead poisoning has occurred during the past year in novel ways, such as the case of the police detective who dusted articles with white lead in searching for finger prints, and the roofers who held galvanized nails in their mouths; also it has occurred through such a well known manner as using an oxyacetylene torch to cut up steel painted with red lead — in this case, a bridge in France which had been blown up.

In the determination of lead in air and in urine, the dithizone method remains in use as the optimum chemical method though the diphenylcarbazide method which it superseded appeared in the 1940 literature for use with biological material. Precipitation in a centrifuge tube at pH 6.6 to 7.4, with separation and washing of the double chromate by centrifuging and final determination without preliminary separation of lead, are features. Polarographic methods are gaining in popularity for rapid determination of small amounts of lead, and methods are being worked out for use of the spectrophotelometer.

Lead has found its way into a number of industries and operations with national defense developments. Defense contracts have specified use of lead chromate as a pigment in departments of automobile plants where non-lead paints have been in almost exclusive use for a number of years. The scarcity of a number of non-ferrous metals is leading to the introduction of alloys containing a high percentage of lead in die castings. Advances in knowledge of lead poisoning control are keeping ahead of such increases in operations involving lead exposures, but it behooves industry and the industrial hygienists to be constantly on the alert to apply these preventive measures before cases of actual poisoning occur.

Solvents

DURING the year, an entirely new group of solvents, the nitroparaffins, were made available in commercial quantities. No recent investigation had been made of their toxicity though it was known that these compounds were irritating and possessed harmful properties. The manufacturers, following what is fortunately a modern tendency, sponsored a thorough study of the toxicology of these compounds, the results of which were reported before the end of the year. This precaution very possibly avoided cases of occupational poisoning with resulting hysteria concerning these useful solvents, inasmuch as they were shown to be toxic. Unlike the paraffin solvents, the nitroparaffins are lethal in concentrations far below those producing narcosis, and beginning narcosis cannot safely be used as a warning of dangerous concentrations. With this knowl-

edge of the effects of nitroparaffins, the valuable group of compounds can find a useful place without jeopardizing the health of the user provided the necessary precautions are observed. Particularly gratifying was the close relation between the two events of release of commercial amounts of these solvents and release of these toxicological data.

Specht and his associates of the U. S. Public Health Service published a bulletin giving experimental results on extended pharmacological studies of 11 ketones. The depression of the various bodily functions was found to be directly proportional to the concentration of the inhaled vapor, to the duration of exposure, and, in the homologous series of straight-chain methyl ketones, to the number of carbon atoms in the chain. The need for study of individual compounds was indicated by the finding that modifications in the molecular structure other than extension of the carbon chain were concomitant with relatively unpredictable narcotic strengths. This work is an indication of the type of integrated investigations which may be expected in the future with the National Institute of Health established in its new quarters.

The U. S. Bureau of Mines has made a start in the publication of its mass of experimental data on benzene. It is hoped that this will be continued and that the Bureau's methanol data can be issued shortly.

Von Oettingen published another of his monumental surveys and interpretations of the literature, this time covering the volatile hydrocarbons. Half of the material is devoted to the aliphatic hydrocarbons, a portion of the field which ordinarily is dismissed much more summarily. Reports of actual cases of poisoning, chronic as well as acute, from such hydrocarbons indicates that serious attention should be given to them, even though appreciably greater exposures can be tolerated without injury than is the case with the aromatic hydrocarbons.

The American Standards Association has made a good start in its program to bring uniformity to the accepted safe limits for vapor concentrations by issuing well-considered figures for benzene and carbon disulphide. The American Standards include properties of the material, the permissible concentration, sampling procedure, analytical methods, bibliography and references for general information. Among the essential elements often omitted from lists of toxic limits is the duration of exposure for which the limiting value is applicable. For benzene, the maximum allowable concentration is given as 100 parts per million parts of air by volume, and for carbon disulphide, 20 parts per million, both for exposures not exceeding a total of eight hours daily.

The increasing realization of the importance of solvent-vapor control throughout all industry has had its effect on the viscose rayon industry. A bulletin on occupational poisoning in this industry was prepared by Alice Hamilton and published by the U. S. Division of Labor Standards. The harmful vapors or gases to which workers in this industry may be exposed are carbon disulphide and hydrogen sulphide. The former is an essential chemical used in the churn rooms to dissolve alkali cellulose and to form cellulose xanthate. In a later step, the xanthate, dissolved in alkali, is forced through dies immersed in an acid bath and thus converted into thread. As the result of the chemical reaction in the bath, some carbon disulphide is again liberated and hydrogen sulphide is formed. In general, concentrations of both carbon disulphide and hydrogen sulphide are easily kept well below the value of 20 parts per million approved by the American Standards Association.

Throughout the industry, it is common practice to ventilate the churn rooms and, better still, to run the churns either under a negative pressure or else to use special churns in which the churn is closed as soon as it receives its charge of alkali cellulose. It remains closed when the xanthation is completed and the xanthate is dissolved in alkali.

In addition to these measures, the American Viscose Corporation has been active in developing a CS_2 recorder which is being shown by Calvert, of the American Viscose Corporation, and McKee, of the Harvard School of Public Health.

It is interesting that two studies on the metabolism of carbon disulfide have followed as a logical sequel to control of the vapor by ventilation devices. Such studies have been reported on other solvents such as alcohol, ether (Haggard), and benzol (Schrenk); and it is to be hoped that they will be made on many other common industrial solvents of interest to industrial hygienists.

Gases

OF THE gases, hydrogen sulfide has had some prominence as discussed above due to its formation in the viscose process. Hydrogen sulfide from the spinning baths has given some trouble in the past and undoubtedly is partly responsible for "sore eyes," a condition which is very rapidly being eliminated throughout the rayon industry. Spinning baths more and more are being enclosed and the process mechanized to such an extent that excellent ventilation is feasible. The American Viscose Corporation cooperated with Philip Drinker of the Harvard School of Public Health in the development of an H_2S recorder utilizing the diethylamine reaction, but recent improvements in ventilation have rendered the need of such a recorder problematical, as it has been the experience of the American Viscose Corporation that concentrations are generally well below 10 PPM. The American Standards Association has set 20 PPM for an eight-hour exposure for this gas.

In addition to the viscose industry, the petroleum industry continues its interest in this gas. The regenerative scrubbing process of vapors before processing in a non-selective polymer plant entailed the handling of hydrogen sulfide in a comparatively pure state. A sampler handling 20 cubic feet of air per minute from 15 different stations was designed and a photo-electric cell type of detector installed to operate an alarm.

The greatest potential exposure to any occupational poison is to carbon monoxide.

The difference between brief and prolonged exposures is taken into consideration by the American Standard released on this gas whereby 100 parts per million is given for the eight-hour exposure and 400 parts per million for exposures not exceeding a total of one hour daily. It is also stipulated that the atmospheric oxygen be not below 19% by volume for the eight hour exposure.

Studies conducted by Heim on the effect of an atmosphere containing 100 parts per million of carbon monoxide at an altitude of 10,000 feet showed that the oxygen-carrying capacity of the hemoglobin was reduced by 10.5%, thereby bringing the blood into a state of anoxemia. The importance of further reducing permissible limits of this gas in airplane compartments operating at reduced atmospheric pressures in high altitudes is thus apparent.

Sulfur dioxide is being used as a diluent of air in magnesium casting to prevent serious oxidation. With production of magnesium castings on the increase, this exposure assumes greater importance.

Hydrogen cyanide has not produced any mass of poisoning cases from the wide use of sodium cyanide metal treating baths found through industry, but a fatal case of poisoning occurred where the molten material spattered on a worker's skin and caused poisoning through absorption of the cyanide.

Ingenious methods sometimes entail unexpected results, as was the case where a nitric acid bath was used as a new method for sharpening old files. At one plant, every worker exposed to the nitrogen oxide gases was injured, one seriously.

Helium-oxygen mixtures have been in use for the alleviation of ear-block among men working under air pressure, and a new apparatus for its administration was devised and published by Brubach, Crisp and Neal, from the National Institute of Health.

Among the gases which are less familiar, decafluorobutane, boiling at 4.5°C. and decafluorocylopentane, boiling at 23°C., were investigated by Plattner, who found that lethal results were produced due to lung irritation.

Dermatitis

THERE was much of importance discovered in the field of occupational dermatoses during the year 1940. Since the field of occupational skin diseases includes such a wide variety of materials, we will refer to only a small number of the outstanding reports on such conditions.

Clothing made of synthetic resins (Pliofilm, Vinylite, and Koroseal) was found to be effective in protecting workers against industrial skin irritants.

An outbreak of dermatitis among the general population was traced to a finish containing a synthetic resin. A method of testing the irritant properties of new fabric finishes before selling them to the public was devised.

An ointment containing an oxidizing chemical such as sodium perborate was found to act as a protective against ivy poisoning.

Occupational leukoderma occurring among workers wearing a certain brand of rubber gloves was found to be caused by an antioxidant, monobenzyl ether of hydroquinone.

Harsh skin cleansers were stressed as causes of industrial dermatitis.

Criteria for the diagnosis of occupational skin disease were formulated by the National Committee of Occupational Dermatoses.

Industries engaged in the defense program were surveyed by Federal and state industrial hygiene units for the purpose of eliminating occupational skin and health hazards.

The first textbook by American authors on occupational diseases of the skin was published.

Abstracts of the literature on occupational and related dermatoses were prepared for publication as U. S. Public Health Bulletin No. 266.

Mercury

FOLLOWING the study of the mercury poisoning hazard in the hatters' fur manufacturing industry, a similar study in the hat manufacturing industry was completed during 1940 by the Connecticut State Department of Health Bureau of Occupational Disease in cooperation with the National Institute of Health. Mercury is present in these plants as a result of the use of a mercury nitrate solution for initial treatment of the rabbit fur of which the felt is made. In addition to the information obtained on exposures in various departments of these plants and the extent of the occupational diseases which resulted, the report provides a real contribution to the knowledge on the subject of mercury poisoning. No cases of poisoning were found among hatters exposed to less than 1.0 milligrams of mercury per 10 cubic meters of air as measured by the Nordlander apparatus.

Stoch continued his researches on mercury poisoning and published results of analyses of mercury content of different human organs.

Welding

ELECTRIC welding has been the subject of much basic investigation during the past year. The results of an epidemiologic and clinical investigation conducted by Drs. Britton and Walsh indicated that among several hundred welders in large plants, no demonstrable injury to health occurred and that the general health of the group was as good as or better than that of the entire working population.

An extensive research on the subject has been carried on by Harrold, Meek and McCord at the Chrysler Industrial Hygiene Laboratories. The significance of this work to National Defense is evident when we appreciate that welders must continue on the job if the many metal products fabricated by welding are to continue to roll off the production lines. These investigators reported that over-emphasis appears to have been placed on

the effects of nitrogen oxide gases, carbon monoxide, ozone and iron fume, the products emanating from the process. They point to the constituents of coatings on rods, coatings on metals, and special constitutents of the metal rod or the metals being welded as possible sources of practical hygienic problems.

Work on the coated welding rod problem was conducted at the Harvard School of Public Health by Tebbins as part of a fellowship project of the Industrial Hygiene Foundation of America, and included a study of the nature and quantity of the fumes and gases liberated during arc welding with coated rods. The General Electric Company contributed equipment and welding experts. This study, too, pointed to the operation as a safe job, provided that the worker observed certain precautions such as avoidance of exposure to ultraviolet light from the arc, provision of ventilation in confined spaces, and limitation of visible fumes to reasonable concentrations.

Similar results were obtained at an investigation conducted at Ohio State University. A preliminary report was released by Case and Castrop, of the General Motors Company, giving results of concentrations of gases and fumes resulting from both electric and acetylene welding.

Ventilation

IN THE field of dust collection, Shepherd and Lapple have presented further data on the performance of cyclones, particularly the effect of the removal of the inlet vane. Hemeon has presented field data on the performance of filter units, and also a general presentation on dust control in the granite industry in Massachusetts.

L. P. Hatch has published a method for designing complete exhaust systems, which makes the engineering approach to a well-balanced system much simpler.

T. Hatch and W. Battista have presented approximate equations for steam-exhaust hood design and also some data on plating-tank ventilation and manifold construction. Silverman, working on an Industrial Hygiene Foundation fellowship, studied the factors affecting hood design for single-slot unheated tanks, such as those used for cold-plating, pickling, acid-dipping, alkali baths, and wash tanks.

The effect of temperature and of solvent characteristics on ventilation requirements, together with the performance of double-slot hoods, is being studied further.

Kravath has published data on the use of the venturi ejector for ventilating paint-spray booths and other types of installation where the direct use of a fan is undesirable. Hemeon has also presented some data on air dilution in ventilation, as applied to both general and local exhaust. In their welding study, Tebbens and Drinker developed information on ventilation requirements showing increases necessary as electrode size increases.

Witheridge and Walworth have given information on the performance of an exhaust system for a degreaser which shows that the conventional horizontal slot method obtains the best results.

T. Hatch has described a low-resistance exhaust system which gives excellent control with a material reduction in power and maintenance cost. Kravath has also shown calculations to emphasize the value of using streamlined fittings and general resistance reduction.

Bacteria in Air

THE field of bacteria in air has been particularly active. Much work has been done on methods of determination, together with results obtained through application of these methods. Among the most active in this field have been DallaValle and Hollaender, together with their associates in the National Institute of Health, and W. F. Wells and his associates.

The effects of ultra-violet radiation and filters on microorganisms suspended in air were studied by this same group. The American Hospital Association released a bulletin on the subject of ultraviolet rays as a sterilization agent in hospitals. Robertson and Doyle published work on the control of air-borne bacteria in operating rooms and hospital wards. Use of ultra-violet radiation in operating rooms was discussed by Kraissel, Cimiotti and Meleney.

Industrial Hygiene Control Agencies

A COMPREHENSIVE discussion of the recent development of industrial hygiene in the United States together with the activities of official and non-official agencies is included in a report released in 1940 entitled "A Preliminary Survey of the Industrial Hygiene Problem in the United States" prepared by Bloomfield and his associates in the National Institute of Health.

Control of Tuberculosis

—Opportunities in the Industrial Health Program—

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TUBERCULOSIS is of especial interest to the industrial hygienist for two reasons. First, because of its essential relation to silicosis, it is a specific occupational disease of those industries which involve an exposure to silica dust. Second, while simple tuberculosis is a disease of the general population, it occurs more frequently among the workers in certain industries than it does among the population as a whole. This does not mean that the industrial environment predisposes to tuberculosis, since the workers' families are also adversely affected. The modern industrial health program, however, con-

Read before the Pennsylvania Tuberculosis Society, Erie, Pennsylvania, April 16, 1941.

cerns itself with the general health of the worker as well as with specific occupational hazards, and tuberculosis must therefore receive consideration beyond its limited significance as an occupational disease. Some aspects of the tuberculosis control program in industry are discussed in the present paper.

Tuberculosis as a Specific Occupational Disease

TUBERCULOSIS has long been recognized as a specific occupational disease of those industries in which the workmen are exposed to silica dust, the etiological importance of which has been clearly demonstrated by studies in this and other countries. The curves in Fig. 1 are sufficient to

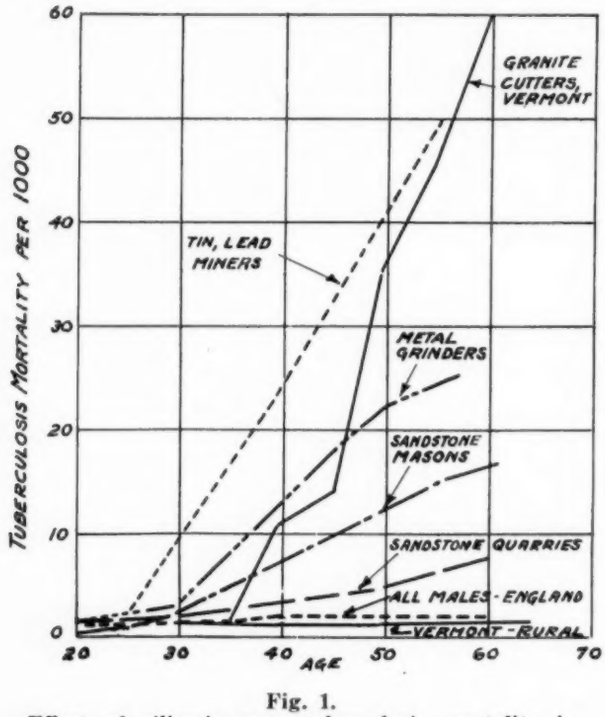

Fig. 1.
Effect of silicosis upon tuberculosis mortality in certain industries.

show how serious the problem has been. In the typical silica industries, without adequate control, tuberculosis is found to be not only excessive but under conditions of extreme dust exposure becomes the predominant cause of death.

It is estimated that more than 1,000,000 industrial workers in the United States are exposed in varying degrees to silica dust. Chief among the industries involved are: Metal-ore and anthracite coal mining; granite quarrying and miscellaneous rock excavating work; manufacture of pottery, glass, and other ceramic products; stone crushing, screening, etc., and foundry operations to some extent. In addition, there are isolated exposures to silica dust in a great variety of industries. Silicosis has even been reported among dental laboratory workers! Thus, the potential silicosis hazard is widespread and the problem it presents is an important one, not only to industry, but also in its relation to the whole tuberculosis control program. Lanza and Vane[1] have called attention to the part which silicosis may play in determining the excessive tuberculosis mortality among industrial workers as compared with the general population.

Effective measures for the control of silicosis have been developed and are being applied successfully in a number of industries. These include both engineering and medical procedures. The latter should be emphasized because of the seriousness of tuberculosis in silicotics. Uncomplicated silicosis is said not to be disabling. Every effort must be made to keep infected persons away from silica dust because of the great personal risk and also because the presence of such individuals greatly increases the hazard to other workers. Pre-employment examinations are required so as to eliminate at the outset all tuberculous workers and others with respiratory infection or evidence of low lung resistance. Periodic examinations thereafter of all exposed workers are also required in order to discover at the earliest possible moment the development of silicosis, and more particularly tuberculosis, among them. In this connection, mention should be made of the danger of spread of infection in the homes of workers suffering from silico-tuberculosis. Early studies of silicosis emphasized the comparatively low tuberculosis mortality among the families of its victims and, as a result, the belief arose that tuberculosis in silicotics was essentially non-infective. With further study this view has been altered somewhat. The organism recovered from the sputum of silicotics is virulent when injected into test animals and it must, therefore, be regarded as infective. The relative freedom of the family from tuberculosis, may be accounted for in part by the fact that tuberculosis superimposed on silicosis generally develops at a late age, after the children have left home.[1] It also progresses to the terminal stage more rapidly than does simple tuberculosis, and the period of exposure of other members of the family is therefore relatively much shorter. It is obvious that these fortuitous advantages cannot safely be relied upon wholly to prevent the spread of infection.

Non-Industrial Tuberculosis and Occupation

THE higher tuberculosis mortality among certain groups of industrial workers, as compared with the general population, has been mentioned. This is accounted for, in the silica industries, by the essential relation between silicosis and tuberculosis. No similar relationship however with other substances encountered in industry has been demonstrated. It has also been pointed out that the greater incidence of the disease is not limited to the workers but is also observed among their families. This suggests that it is the domestic rather than industrial environment which produces the unfavorable experience. Such domestic factors as over-crowding and malnutrition and others which may be measured in terms of economic status, are known adversely to affect the tuberculosis mortality. A partial test of the relative importance of the domestic and

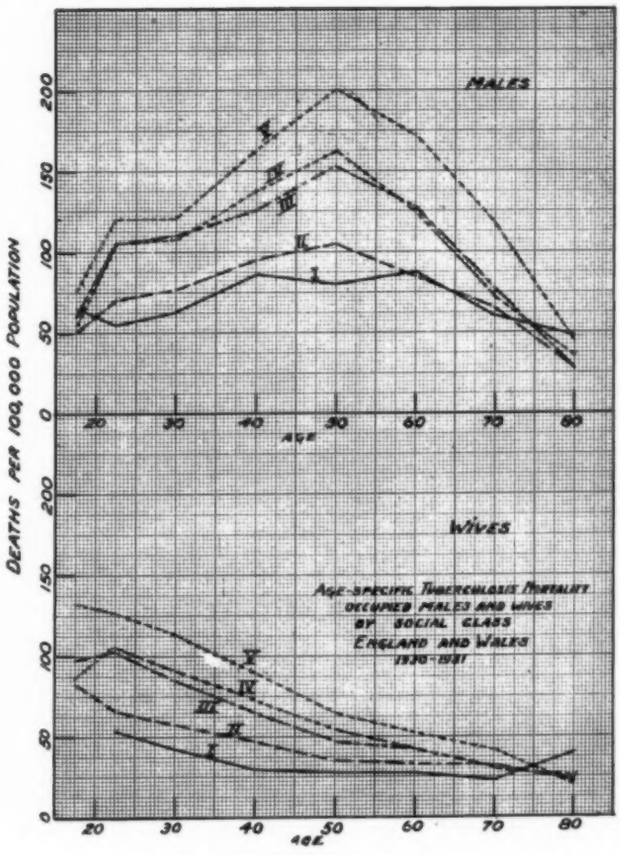
MALES
WIVES
DEATHS PER 100,000 POPULATION
AGE
AGE-SPECIFIC TUBERCULOSIS MORTALITY OCCUPIED MALES AND WIVES BY SOCIAL CLASS ENGLAND AND WALES 1930-1931

Fig. 2.
Age-specific tuberculosis mortality for occupied males and their wives, by economic class, England and Wales, 1930-31.

industrial environments may be made by comparing the tuberculosis mortality of industrial workers in various occupation groups in relation to all males, with that of their wives relative to all women. If industry itself has an adverse effect with respect to tuberculosis one would expect it to be reflected in a higher standard mortality ratio for the occupied men than for their wives who are employed in industry to a much less extent but who are subject to the same economic limitations and domestic environment. In the following graphs, this test has been applied to the mortality data for various occupations and economic classes in England and Wales for the year 1930-31.* In Fig. 2, the age-specific death rates from tuberculosis are shown for occupied men and their wives in five industrial classes.** It will be observed that for both men and women the mortality increases with decreasing economic status. The age-distribution curves retain the same characteristic shape in all five classes with the maximum mortality rate at age 50 for the men and around age 20 for the women. In order to draw any conclusion from these data, it is necessary to convert them to a common basis for comparison. This is done for the five groups in Fig. 3, using the standard mortality ratio*** as the parameter. Except in Classes I and V, the ratios for the men and women are alike. In Class I, the highest economic group, the women have a slight advantage whereas in Class V, the men had relatively less tuberculosis.

These findings indicate that the industrial environment, generally, does not play a direct part in determining the tuberculosis mortality among occupied males. Further indications of this are found in a study of the various occupations which make up the five economic groups. Within most of these groups no statistically significant differences between the ratios for husbands and wives were found. Those which did differ significantly are shown in Fig. 4, and in the majority of them the relative mortality for the wives was higher than for the occupied men. Exceptions include such occupations as hairdressers and innkeepers, in which physical selection for the job plays a part, and others which involve exposure to silica dust such as masons. In a more elaborate statistical analysis of the problem, Collis and Greenwood[2] reached the same conclusion concerning the influence of the industrial environment upon

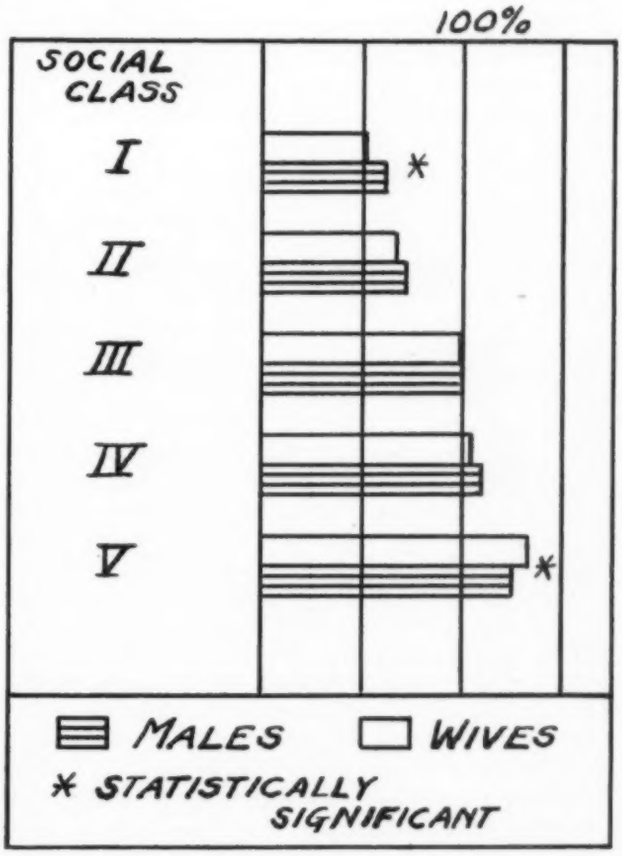

Fig. 3.
Standard tuberculosis mortality ratios for occupied males and their wives, by economic class. England and Wales, 1930-31. Note that in each class the ratios do not differ markedly.

*I am indebted to MISS ELIZABETH H. PITNEY, Research Secretary, Philadelphia Health Council and Tuberculosis Committee, for the analyses of these data. British data were employed since U. S. records are not available in the desired form.

**The five groups are divided approximately, as follows:
Class I: Professional
Class II: Semi-professional
Class III: Skilled workers
Class IV: Semi-skilled workers
Class V: Unskilled workers

***The standard mortality ratio is the ratio (expressed as a percentage) of the mortality for a particular group to the mortality for the entire population under study, both adjusted to the same age distribution. Equal standard mortality ratios for husbands and wives in a particular group means that the difference in their death rates is the same as the difference among all men and all women.

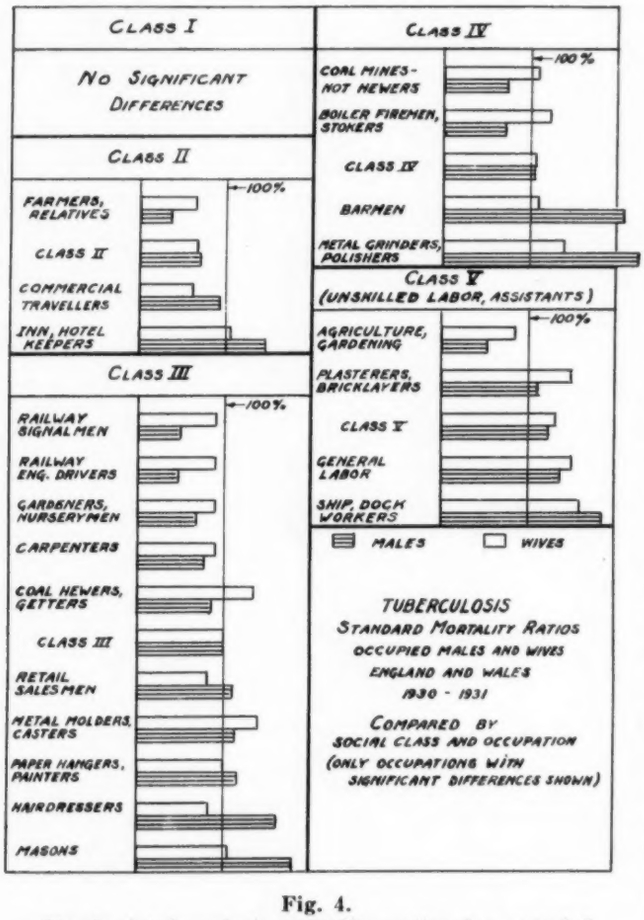

Fig. 4.
Standard tuberculosis mortality ratios for occupied males and their wives, by occupation, England and Wales, 1930-31. Note that in the greater number of cases, the mortality ratio is higher for the women. Exceptions include masons and metal grinders, and certain occupations which do not require rugged individuals.

tuberculosis mortality. It is of interest to note, however, that they found, by the method of partial correlation, a greater sensitivity among the men to the unsatisfactory home environment than among women, and attributed this to the lowered resistance resulting from the wear and tear of industry. More recently, Hart[3] has called attention to the relation between the *retardation* of the decline in tuberculosis mortality among young women since 1900 and the increase in the percentage of women employed in industry, which suggests that competitive industrial life is less favorable than the sheltered home environment of previous generations. This, however, is not necessarily an indictment of the physical environment in industry since there are important psychic factors involved as well.

Tuberculosis Case Finding in Industry

IN THE modern tuberculosis control program, great emphasis is placed upon the early discovery and isolation of active cases of the disease in order to reduce to a minimum the opportunity for contact between infected and susceptible persons. This involves a program of mass case finding, which, for most effective results, should be conducted among those groups in the general population in which the greatest number of cases is likely to be found. This criterion cannot always be met because of the administrative difficulty and expense involved in reaching the most important groups. Since the schools provide convenient aggregations of individuals for mass examinations much effective work has been done in this group despite the fact that neither the mortality nor the incidence of the disease is highest among youths of school age. Expansion of the medical program in modern industry, with its routine physical examination of thousands of workers, offers an unparalleled opportunity for tuberculosis case finding. Is there an advantage, statistically, in mass survey work among this group, as compared with other age groups?

At the present time the tuberculosis mortality rate is highest for males at age 55. This does not mean, however, that the relative risk of contracting the disease is also the highest at this age. Frost[4] showed, on the contrary, that the high death rate in late life today is the result of a much higher relative risk at earlier ages. Tracing the experience in Massachusetts of "cohorts," i.e., groups born in successive decades from 1870 to 1910, he found that the relative risk of contracting tuberculosis at different ages has maintained a substantially constant relation to the mortality during the first decade of life despite the tremendous reduction in the death rate for all ages since 1870. Assigning a value of 1.0 to the mor-

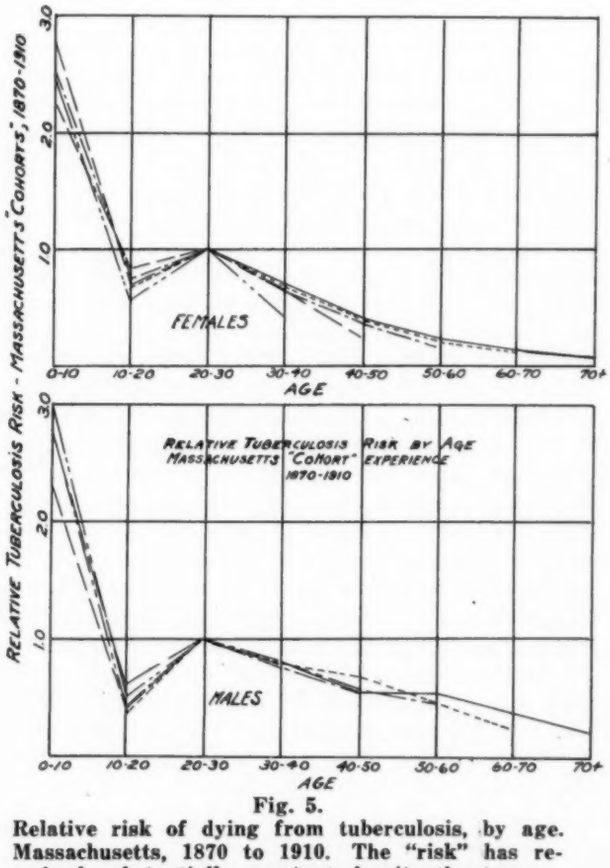

Fig. 5.
Relative risk of dying from tuberculosis, by age. Massachusetts, 1870 to 1910. The "risk" has remained substantially constant despite the tremendous decrease in tuberculosis mortality.

tality at age 25, the relative risk at other ages for successive cohorts since 1870-80 has been calculated with the results shown in Fig. 5. The curves of relative risk thus obtained exhibit approximately equal maximum values in early childhood followed by a marked drop up to the beginning of adolescence after which they rise to reach a second maximum at age 25. Beyond this peak the risk decreases gradually with advancing age.

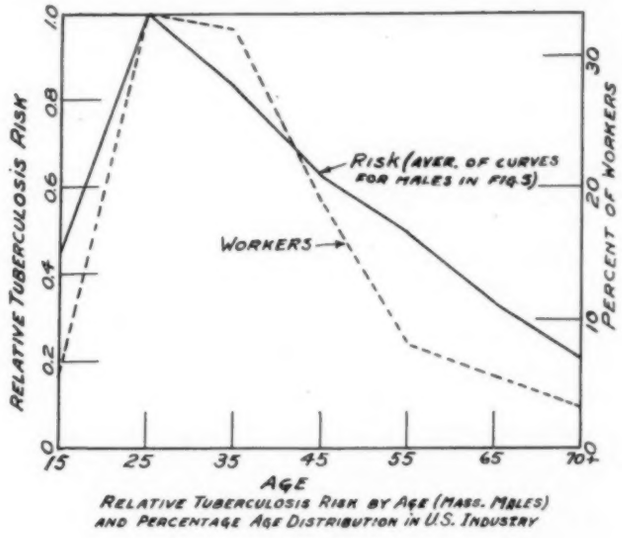

Fig. 6.
Relative tuberculosis risk by age (Mass. males) in relation to the age distribution of industrial workers. The period of greatest risk occurs in the age-group having the greatest number of industrial workers.

The similarity of the curves shows that the relative risk of dying from tuberculosis at different ages has remained substantially constant despite the tremendous drop in the mortality rate since 1870. Downes[5] has called attention to the fact that the relative *incidence* of tuberculosis at different ages has a similar shape with the two maxima occurring within the same age periods. These observations are highly significant since they indicate clearly the salient points of attack against tuberculosis, namely, in early childhood and in the period centering around age 25. This is of particular interest in the present discussion because of the fact that the majority of industrial workers fall within the age-group of maximum tuberculosis risk, as shown in Fig. 6. The close parallel between the two curves suggests at once that for effective tuberculosis case finding beyond childhood, mass survey work in industry offers unusual opportunities. Not only are adults in the vital age group brought together in large aggregations, but, under the modern industrial health program, they can be reached more easily than any other adult group, with the exception of those in the armed forces. Thus, the work of the industrial medical department assumes great importance in the national tuberculosis control program. It must be pointed out, however, that industrial medical services are not yet widespread. No more than one-third of the workers have the benefit of physical examination and the other medical attention which industry can provide. The opportunities for tuberculosis control in industry furnish a strong argument, among others, for the extension of such services.

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Controlled Radium Hazards

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I AM confining myself in this paper to the preventive measures which have been developed in the luminous dial painting industry. With World War II demands, the number of persons engaged in this industry has increased very rapidly. One plant which I know of is now employing between 200 to 300 persons as compared with 35 to 40 employees before the war started.

Radioactive luminous compounds are known under different names. This term includes "radioactive luminous compound," luminous material or "radium paint," all of which refer to a mixture of phosphorescent zinc sulfide and radium, mesothorium or any other radioactive substance.

During World War I the industry employed a number of workers among whom cases of radium poisoning developed in the early twenties. Radium poisoning in this sense was used to distinguish the damage caused by deposition of radium in the body, as against damage caused entirely by external radiation. Radium poisoning was unrecognized in medical history until cases appearing among dial painters were diagnosed by Martland as resulting from ingested radioactive material. As is commonly known it was the habit of the painter to point the brush between the lips and in this way particles of the paint were taken into the mouth and swallowed.

About 1924 I was asked to assist Dr. Gilman Thompson who was engaged by one of the insurance companies to study the luminous paint industry and to determine the hazards existing at that time. As soon as the first cases appeared the habit of pointing the brush between the lips ceased. An investigation of the industry revealed

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certain important information and indicated what steps were necessary to safeguard the health of the worker. From time to time new preventive measures are being developed as suggested by observations of the work.

A review of the industry revealed that previous to 1924 the employee was not given a pre-employment medical examination nor was she given an examination while she was employed. A frail girl or one with some physical defect was often given preference because it was felt that this was the kind of work she could do without overtiring herself. No information was given the new employee as to the hazard of the work for the simple reason that the heads of the company had no conception that it was a dangerous occupation. Patients in Europe and to some extent in this country had been receiving injections of radium salts and no deaths had been reported following such therapeutic treatment. In fact ampules of radium chloride were on the list of new and non-official remedies of the American Medical Association. Signs were placed in the work rooms forbidding the pointing of the brush between the lips but this regulation was not enforced. In my studies I soon found that the girl who was engaged in teaching the workers in the different plants told them, "You are not supposed to put the brush to your mouth but you can make more money that way."

The salary at that time was on a piece-work basis. One cannot blame the young lady because she did not know of the danger herself.

The girls worked at benches close to each other in many of the plants, and there was no ventilation other than that provided by windows. The work benches were of wood and spilled material could not be removed. A visit to the rooms at night showed them to be luminous from the careless handling of the material during the work period. The girls got paint on their hands when mixing the dry material with the adhesive or in other operations. If taken into a dark room luminous material could be seen on the body and the hair. I have been informed by other members of the family that grains of the material would drop out of the girl's clothing when she disrobed at night. Often a girl would paint a design on her forehead or arms when going to a dance. On Hallowe'en some of them even painted their teeth. In general one can say that both the personal hygiene and the plant housekeeping were on a low level.

In some of the plants the workers were crowded into too small a room and the amount of emanations which built up during the working period was higher than should have been.

To an industrial hygienist there was no difficulty in knowing where to begin to improve working conditions.

THE recognized hazards in the work can be classified in order of importance as follows:

1. Ingestion or inhalation of solid radioactive luminous compound;
2. Inhalation of radon liberated from compound into the air, and
3. Exposure of whole body to gamma radiation from compound.

The chance inhalation of the dust is rather small as compared with the chance ingestion of the paint. The particle size is such that practically none will pass a 350-mesh screen. The danger of inhalation rests mainly in the repair work where the paint is removed from the surface by scraping with a sharp knife or similar instrument, or in mixing the paint with the adhesive, when the near-sighted worker may hold her head very close to the mixing crucible. From the time it is mixed with the adhesive the luminous material is wet and there is no danger that it will rise into the air.

The damage done by inhaling the emanation is still on a theoretical basis and depends for its warning signals from the experience in the mines of Schneeberg and Joachinthal. It is well recognized that high concentrations of emanation are dangerous and will cause death. The picture of such an exposure is one of profound anemia and the skeletal destruction seen in the dial painter's picture is not present. I have seen histological sections in the laboratories of Madame Curie that showed a nephritic condition when polonium was present—one of the decay products of emanation. If any pathologic effects are found in the dial painter we would expect them to appear along the line of lung cancer. Although I have been watching some of these girls for 16 years I have not found any suspicion of lung cancer. However it is a matter of great importance, or it is an important precautionary measure to keep the emanations in the air at a minimum.

Nor have we as yet found any damage from the gamma radiation which is present in the work room. But here again it may be a matter of time, and the amount of radiation that the whole body of the employee is exposed to must be kept at a minimum. Our experience has indicated that the first sign of an over exposure to emanation and gamma ray is a change in the blood picture, especially a drop in the white cells. If the condition in the plant is remedied, the blood picture returns quickly to normal. It is because of these findings that the blood picture is important in this industry.

THE first precautions introduced into the industry were a periodic examination of the worker, the enforcement of better personal hygiene and an improvement in the general housekeeping of the plant. These measures have been responsible for the improvement in the health of the worker. Since the practice of pointing the brush between the lips has ceased, I have not found any employee who has shown radioactivty.

When a person applies for employment she is given a physical examination. This examination includes the usual heart, lung and nervous reactions as well as urine and blood tests. No applicant who is not in good condition or who shows a previous history of anemia or tuberculosis is em-

ployed. Menstrual irregularity and history of any disease of the skeleton indicate that the girl should not be engaged in this work. The prospective employees are instructed that their teeth must be put in good condition within a short time after they have been taken into the shop. In addition it is important that only workers who are naturally neat and careful should be employed. Continued carelessness or untidiness in handling the material during the training period is a reason for dismissal.

When a worker is accepted she is informed in detail of all the hazards involved. She is instructed as to the rules and regulations which have been set up for her protection and is informed that if she violates them it will mean her dismissal. In the future a handbook, which has just been published by the Bureau of Standards,[1] containing the recommendations which have been drawn up by a committee for this purpose, will be given each employee.

Each worker is examined once a year or preferably every six months. A physical examination is made as well as a blood study and a radioactive measurement of the radon content of the expired air. It is recommended that the radon test be used rather than the electroscopic or Geiger counter examination. If the expired air should indicate that the employee has more than 0.1 microgram of radium deposited in the body, she is taken off the work and an investigation is made at once to determine what conditions exist in the working area that may have caused the worker to become radioactive. It is believed that if no more than 0.10 of a microgram of radium is present in the body no serious harm will result. However if its presence is discovered at an early period it may be eliminated by decalcifying treatment. This is only possible when radioactive material is in the trabeculae of the bone. Once it is deposited in the cortex of the bone it is impossible to get rid of it and bone destruction will occur. Even if bone regeneration should take place it is only a temporary condition for the process of bone destruction will continue—anyone else to the contrary.

The blood tests which are made at regular intervals very seldom show any clinical symptoms unless a case is involved in which radium poisoning has existed for some time. The most important part of the examination is the determination of radioactivity, but the blood picture is important because it will indicate an over exposure to gamma rays or radon.

The hands, hair and working costumes of the personnel are examined daily by means of an argon or ultra-violet lamp in a dark room for traces of luminous material. If any is detected it is removed with a little of the adhesive. Recently a nurse was engaged by one of the companies to examine the girls for any indication of carelessness in observance of precautionary regulations. This inspection includes:

(a) An examination under the lamp to detect the presence of luminous material.

(b) Inspection of the bench at which the girl is working to see that no candy or gum is kept there. It is against the rules to have anything on the bench except the instruments and material used in the painting operation.

(c) Inspection of the drawer of the work table to see that it contains nothing but the pocketbook and towel.

(d) Similar careful inspection of the lunch and rest rooms is made in order that they may be kept free of luminous material.

The finished work is removed from the work bench frequently and is placed in drying cabinets with exhaust systems. These cabinets are located away from the area occupied by the workers. The stock material is stored in a safe with a one-inch lining, and placed far from the room in which the painting takes place.

Girls engaged in weighing out radioactive material into gram bottles do so under a hood with a good exhaust system and wear a respirator which has been approved by the United States Bureau of Mines.

Applied radioactive luminous compound is frequently removed in repair work preparatory to repainting. The luminous compound must be removed by scraping under liquid. If this liquid is an organic solvent, gloves resistant to the solvent must be provided and must work. This compound contains all of the original radium and is just as dangerous to handle as the fresh compound. Any operation of this kind that must be done in the dry state should be carried on under a hood with forced ventilation to the outside air, and the operator must wear a respirator approved by the U. S. Bureau of Mines.

Working Room

IN order to promote good housekeeping, working conditions have been arranged so as to provide a generally safe environment for the workers, and to encourage their cooperation in carrying out the rules intended to preclude any possible known hazard. The working room is so ventilated that the amount of radon in the atmosphere is kept at a minimum. It is not allowed to reach a concentration higher than 10^{-11} curies per cubic liter of air.

If any higher content is shown, the plant is carefully examined by means of a Geiger-Muller counter to determine where any radioactive material may have accumulated. It is for this reason, and also because it has been found desirable not to expose the entire body of the worker to more than 0.1 roentgen per working day, that finished work is not permitted to accumulate at the tables, but is kept in drying racks with proper ventilation.

To further assure these conditions, special attention has been paid to the floors and working tables. Wooden floors with their inevitable cracks furnish a place for the accumulation of any spilled luminous material. Therefore, a smooth continuous surface such as painted concrete or linoleum has been provided. The rooms are cleaned each day by wet mopping to avoid throwing dry dust

into the air. The tables at which the painters work are so spaced that each has at least 12 square feet of floor space. This prevents over-crowding and at the same time reduces the exposure to gamma rays.

The tables used for dial painting, weighing and other manipulation of luminous compound also have a glazed porcelain or other smooth continuous surface, impervious to moisture and solvents used with the adhesive. While they are, perhaps, not necessary, the company whose employees we have examined for radioactivity, has found that hoods connected with each table apparently furnish additional protection to the worker. These are glass hoods with an air movement of from 20 to 40 cubic feet per minute. Before and after each working period the revolution of the air pump is increased three or four times to assure the complete removal of any emanations that may have gathered. It is my opinion that the advantage of the hoods lies in the fact that any accumulation of active deposits can be removed more readily from the hoods than from walls and ceilings, where material may settle if painting is done on an open table. That it is a good system is indicated by the fact that when the premises were examined by officials, the air of the room was found to be satisfactory and there was no dust in the atmosphere where the girl came in contact with it. Furthermore, a Geiger count gave no indication of an accumulation of active deposit in the air ducts.

Each individual is provided with a porcelain crucible set in a lead block so that her fingers do not come in contact with the luminous compound while mixing the paint with the adhesive. The worker is given only one gram of paint at a time except in very special work. Bottles containing more than one gram of material are set in a lead block to cut down the increased amount of radiation which would be present. The tops of the tables are lined with lead. It is questionable if enough gamma rays could go through the top of the table and strike the limbs of the painter, but it has a psychological effect and serves to impress on the employee that she is working with a dangerous material. A rack is furnished to hold the brush when it is not in use. Sheets of paper are at hand for cleaning the brush or for wiping up any spilled material. The paper is used only once and then thrown into a container. The containers are removed once a day, the papers burned, and the material recovered.

The girls wear smocks which are laundered at the expense of the company each week. These are used only during the working period and are left in the lockers located in the dressing room at the end of each day.

The credit for these improvements is due to the careful study by the companies engaged in this industry.

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Variation of Bacterial Population

—In Certain Ventilating Systems—

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THE use of artificial ventilating systems has produced a number of problems in connection with the distribution of bacteria in offices, laboratories, and workrooms. The problems which will be discussed here are:

First, are bacteria which are released in certain rooms in a building with recirculation distributed readily all over the building?

Second, how does the bacterial population vary in a building with artificial ventilation in the course of a year?

Third, what are some of the factors which influence the size of the bacterial population?

The investigation to be described was carried out in the Industrial Hygiene Building of the National Institute of Health in Bethesda. This building is located on a fairly high plateau on a 70-acre tract, partly wooded and partly in lawn. Roads on this reservation are tarred. There are no stables in the neighborhood of this building. Laboratory animals are kept in certain rooms with separate ventilation systems. The building has a capacity of 363,750 cubic feet. It has one office floor, two laboratory floors, and two basements, used as laboratories and workshops. The attic is not connected with the general ventilating system. The air intake is in the sub-basement and the air is filtered through a moving oil filter with an efficiency of about 40 to 50% for the removal of bacteria. The air is pre-heated before entering the filter system and humidified after passing through the filter.

In the early part of this investigation up to 60% of the air was recirculated. During 1940 air was recirculated only if the outside temperature came down below 20°F. About seven air changes took place per hour.

Approximately 70 people occupy this building, with about 30 people working on the first floor. The rest of the workers are about evenly distributed on the remaining floors.

Two methods of sampling were used. Most determinations were made with the funnel sampler (Fig. 1). This device, of simple construction, lets measured quantities of air impinge through a funnel on a standard agar plate. Typical results obtained after these plates were incubated for 48 hours are given in Fig. 2. Occasionally the Wells centrifuge was used simultaneously with the funnel device. The results obtained with the two devices checked fairly closely. Both devices showed a large variation in individual samples taken. Most of the samples were taken on standard meat agar, incubated for 48 hours at 30°C

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and 24 hours at 37°C. Occasionally potato dextrose agar plates were used for the detection of fungi. All colonies were counted independent of whether they were bacterial or fungous colonies. The types of organisms obtained during the last few months were analyzed by Mr. Schneiter, bacteriologist in this laboratory. In general, most organisms obtained were of the saprophytic type; occasionally staphylococci were found. However, since only one medium was used for obtaining these bacteria, it may very well be possible that pathogenic organisms of the streptococcus type were missed in our sampling. Three single samples were taken in each room. Sampling time usually was five minutes per sample, five cubic feet per sample. Three rooms were tested on each floor with the exception of the first floor (office) where six were sampled. All samples were taken at about table level. A total of 22 sampling stations were used.

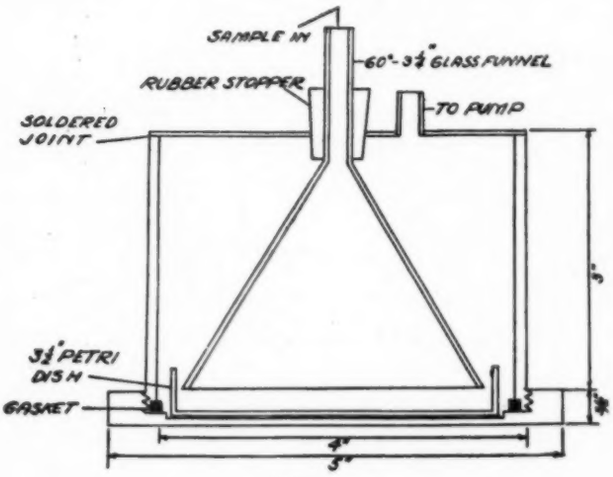

Fig. 1.
Funnel device used for sampling air-borne bacteria.

To test the efficiency of this ventilating system for the transmission of bacteria, the following experiments were conducted. Bacteria was spread into the recirculation intake on the first floor and simultaneous samples were taken in the plenum as well as in rooms on the first and second floors, before, during, and for two hours after spraying of the organisms. To be able to recognize the organisms sprayed into the ventilating system, we used *B. subtilis* spores which form colonies on meat agar easily distinguishable from other types of bacterial organisms. Fig. 3 shows the change of bacterial population on these different floors. The bacterial population was very low before spraying of these organisms. A few minutes after the bacteria were sprayed into the ventilating system, the population in the different rooms had increased many-fold. After the spraying of the bacteria was discontinued, the level of the bacterial population stayed fairly high for another half an hour and then slowly decreased to its former low level. This decrease may be attributed to the dilution factor, to the action of the filter, loss to surfaces such as walls, floors, and the like. It would be worthwhile to investigate the disappearance of bacteria as influenced by humidity, temperature, and other factors.

It should be kept in mind that these data have been obtained with *B. subtilis* spores, an extremely resistant organism which will stand adverse humidity conditions. Many vegetative forms of bacteria probably would not be transmitted by the ventilating system as readily.

I will now describe typical results obtained in the monthly survey conducted for the last two years. First of these spot diagrams (Fig. 4) shows the variation of bacterial population in a laboratory room on the third floor. During the first months of 1939, up to about August, workmen were still installing equipment in this room. During the time from October, 1939, to December, 1939, this room was used on and off as a storage room. During the first part of 1939 hardly any worker entered this laboratory. In August, 1940,

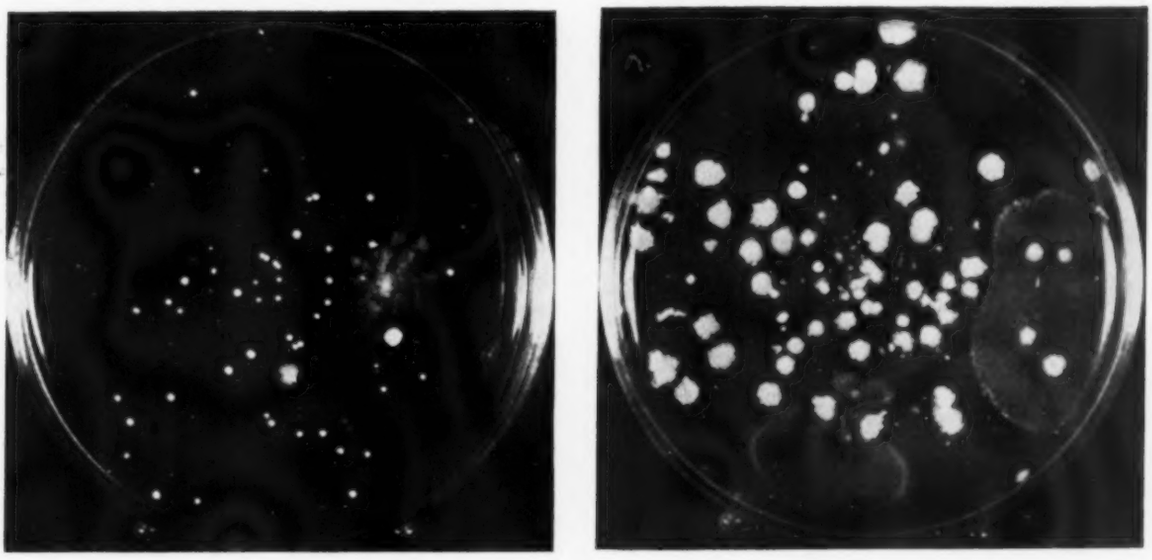

Fig. 2.
Petri dish cultures obtained with funnel device. (Left) sample obtained before spraying of bacteria. (Right) sample obtained after spraying of B. subtilis spores (notice diffuse colonies of B. subtilis).

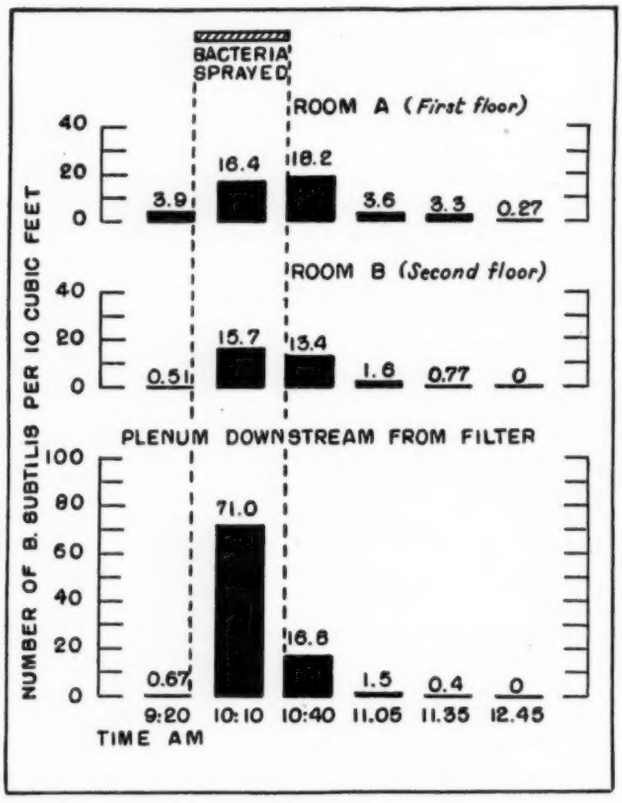

Fig. 3.
Number of B. subtilis colonies per 10 cubic feet of air from samples taken simultaneously on different floors. Bacteria spread into outside air intake between 9:30 and 10:40 A.M.

this room was inspected by a group of workers who in September occupied this laboratory. As soon as activity started in this room, the bacterial population increased five or six-fold. Later on, after the installation of new equipment was completed, the bacterial population came down to a lower level, but never returned to the level it had taken when the room was not occupied.

The next figure (Fig. 5) shows the bacterial population for two years on our office floor which has the largest number of occupants of any floor in the building. During the first months of 1939, old records, office equipment, etc., were moved in. By June and July the staff and equipment for

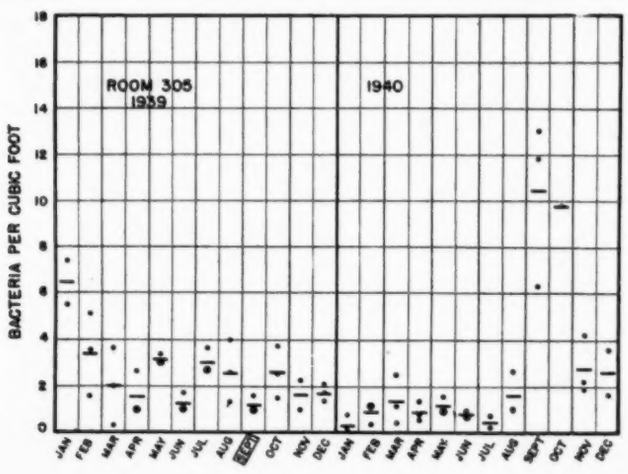

Fig. 4.

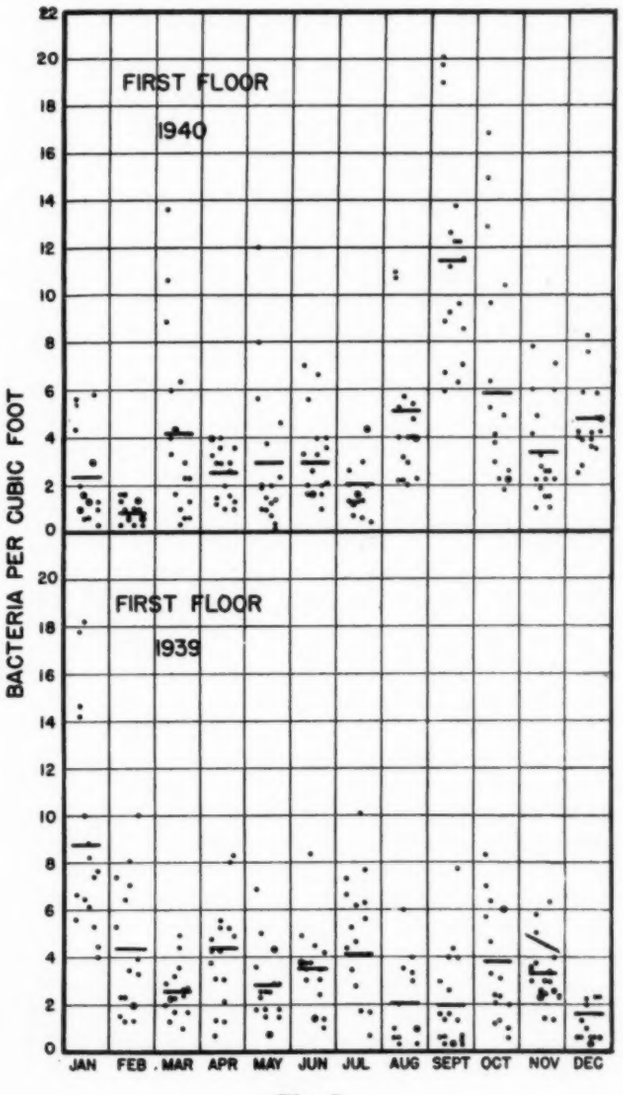

Fig. 5.

the laboratory floors moved into this building, increasing the number of bacteria in the system. Usually during the fall months, October and November, the bacterial population increases on most floors. This is partly caused by the large number of bacterial and fungous spores in the outside atmosphere during these months. In general, when the ventilating system begins to distribute air in the building, some dust which collected in the vents and the outlets is blown into the rooms. Further, the air currents produced by air coming from the ventilating system probably disturbs settled dust in different localities. The bacterial population in September, 1940, increased manyfold. This was caused by the fact that a number of sheep and goats, used for experimental purposes, were kept near the air intake of the ventilating system. After these animals were removed, the bacterial population went down fairly rapidly.

The following figure (Fig. 6) shows the results from a typical laboratory floor with a small number of workers. In the early part of 1939 workmen were still occupied in installing electrical equipment on this floor. The usual increase of

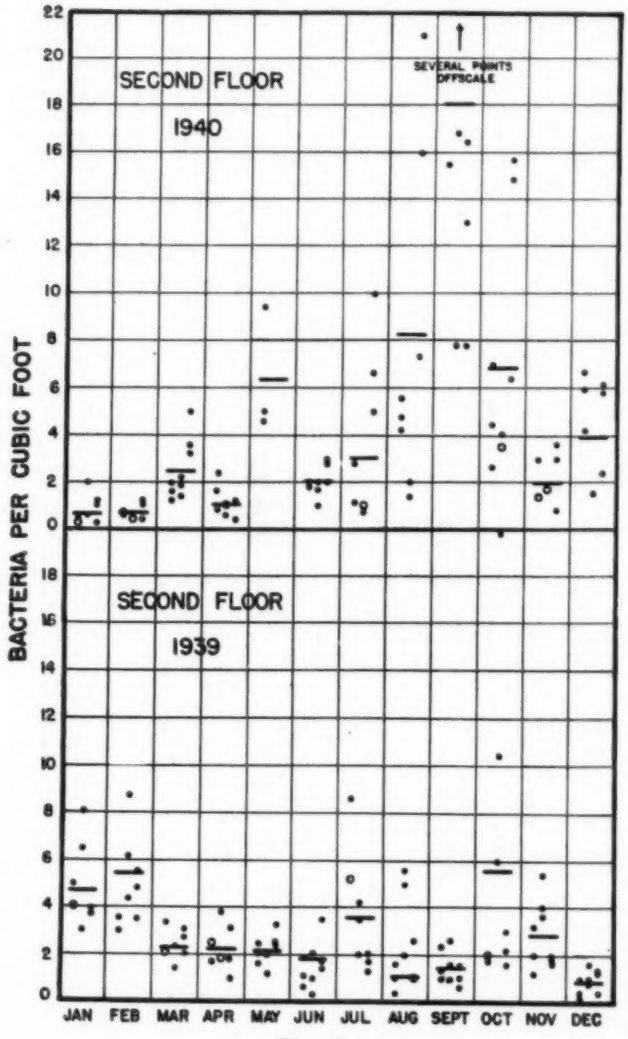

Fig. 6.

bacteria in October and November took place. Very striking again is the tremendous increase of bacterial population in August, September, and October of 1940 caused, as mentioned before, by the keeping of animals close to the air intake of the ventilating system.

The attic of this building is used as a store room. In the early part of 1939 a large amount of old records and laboratory equipment was put into storage on this floor. Beginning in October, 1939, animals were brought to this floor. Beginning with July and August, 1940, a number of sheep and a small supply of hay were also kept on the attic floor. This is probably responsible for the very high bacterial population on this floor.

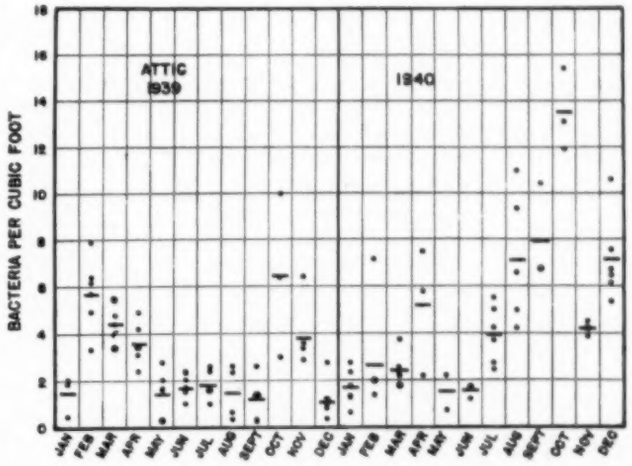

Fig. 7.

A survey was made of the bacterial population in the outside atmosphere. In general, the number of fungous spores found outside was higher than in the building. A record was kept for the times windows were opened in the different rooms. In general, bacterial variation with windows open was not much different than when the windows were closed. One reason for this is that the draft created by open windows helped to keep a large amount of dust in suspension. If there was very much movement in the room occasionally the bacterial population was higher than if only one person was sitting at his desk. It was found that if workmen had their lunch in certain rooms and left scraps around, the bacterial population would increase.

The variation in the two successive years was not very large except as unusual conditions made for increased bacterial population, as for instance, keeping of animals close to the air intake of the ventilating system.

It should be kept in mind that many factors tended to keep the bacterial population to a very low level in the building tested. One is the location of the building away from any population or factory center. The ventilating system may become a source of bacterial contamination by keeping in crevices and corners, dust and bacteria. When the outside atmosphere clears, this might contribute a considerable percentage of the bacterial population in the building. The filter used in this building cannot be a source of bacteria, since no organisms will grow on the bactericidal oil used in the system.

Constitution and By-Laws

—of The American Industrial Hygiene Association—

THE constitutional committee presented to the business meeting of the AMERICAN INDUSTRIAL HYGIENE ASSOCIATION a revised constitution based on the instrument originally drawn up by the founders of the Association but closely adapted to its permanent needs.

This constitution was discussed before the meeting and suggested changes incorporated by the committee. On circulation to the entire membership of the Association, this constitution as given below was adopted on July 15, 1941.

ARTICLE I—NAME

THE name and title of this organization shall be the AMERICAN INDUSTRIAL HYGIENE ASSOCIATION.

ARTICLE II—OBJECT

The object of the Association shall be to increase the knowledge of industrial hygiene through interchange and dissemination of information; to promote the study and control of environmental factors affecting the health and well-being of industrial workers; to correlate such activities as are conducted by individuals and agencies throughout industrial, educational and governmental groups; and to bring together persons interested in the various phases of industrial hygiene.

ARTICLE III—MEMBERSHIP

Section 1. Members shall be persons who are engaged in industrial hygiene activities.

Section 2. Approval by two thirds of the Board of Directors shall be required for election to membership.

ARTICLE IV—OFFICERS

Section 1. The officers of the Association shall be a president, a president-elect, a secretary, and a treasurer. The President-elect, Secretary, and Treasurer shall be elected annually by the members of the Association and shall serve until their successors are elected and installed. The President-elect shall automatically accede to the Presidency on election and installation of his successor.

Section 2. An Executive Secretary may be appointed by the Board of Directors. He need not be a member of the Association and shall hold his office at the pleasure of the Board of Directors.

Section 3. The President shall appoint such committees as are deemed necessary and shall automatically become an ex-officio member of such committees. The personnel of such committees shall be approved by the Board of Directors.

ARTICLE V—ADMINISTRATION

Section 1. The Association shall be governed by the Board of Directors except as otherwise herein expressly provided. They shall delegate to an executive committee authority to administer the affairs of the Association as set forth in the By-Laws.

Section 2. The Board of Directors shall consist of nine elective directors, the four officers, and the two most recent past presidents. The President of the Association shall serve as Chairman of the Board of Directors.

Section 3. Three elective directors shall be elected each year and each shall serve for a term of three years.

Section 4. The Executive Committee shall consist of the four officers of the Association and the two most recent past presidents.

ARTICLE VI—LOCAL GROUPS AND AFFILIATIONS

Section 1. The Board of Directors shall have the power to foster the formation of Local Sections. The Board of Directors shall consider an application from six or more members of the Association to establish a Local Section and the Board of Directors shall establish the geographical area of such sections.

Section 2. The Board of Directors may establish reciprocal relations with any local or national organization whose work and activities are closely allied to industrial hygiene. A group of this nature may become an affiliated society under conditions set up by the Board of Directors.

ARTICLE VII—AMENDMENTS

Amendments to this Constitution may be proposed at any Annual Meeting and must receive a three-fourths affirmative vote of the members present and voting. Proposed amendments must be circulated to the voting membership with a letter ballot. A three-fourths affirmative vote of all ballots returned within thirty days shall be required for adoption.

By-Laws

ARTICLE I—MEETINGS

SECTION 1. The Annual Meeting of the Association shall be held at the time and place selected by the Board of Directors. In making arrangements for meetings, the Board of Directors shall, insofar as is feasible, join or affiliate with organizations that have a common interest. There shall be at least one business session during the Annual Meeting.

Section 2. Notice of all general meetings of the Association shall be sent to the members by the Secretary at least thirty days in advance of the date set for them.

Section 3. Twenty per cent of the members eligible to vote shall constitute a quorum.

Section 4. The Secretary, on direction of the President, shall notify in writing each member of the Board of Directors at least two weeks in advance of a meeting, as to the time, place and purpose of the meeting of the Board of Directors. A majority of the Board of Directors shall constitute a quorum.

ARTICLE II—MEMBERSHIP

Section 1. The Board of Directors may elect to membership in the Association reputable persons who have been engaged in some form of industrial hygiene activity for at least three years and have been graduated from an accredited school of college grade or have had equivalent training. Graduate study may be accepted in place of part or all of the required period of industrial hygiene activity.

Section 2. Application for membership shall be made on a form approved by the Board of Directors. Each applicant must be sponsored by two members in good standing, one of whom resides in the same geographical area as the applicant.

Section 3. The dues shall be $3.00 per year. Dues become payable on the first day of January of each year.

Section 4. Any member whose dues are unpaid on March 1, is not in good standing, and he shall have no vote. When the dues of any member shall not be paid within one year after they are due, his membership is automatically terminated.

Section 5. Any member dropped for non-payment of dues may be reinstated at any time previous to the convening of the Annual Meeting of the year following his delinquency by payment of dues in arrears and also the dues for the current year.

ARTICLE III—ELECTION OF OFFICERS AND DIRECTORS

Section 1. Nominations for officers and elective directors shall be made by a nominating committee of three members to be appointed by the President. Each member of the Nominating Committee shall be from a different Local Section or geographical area. At least sixty days prior to the Annual Meeting the Nominating Committee shall select two nominees for each elective office and shall select five nominees for elective directors. The list of nominations shall be mailed to each member of the Association. The members will vote and return their ballots not later than two weeks prior to the Annual Meeting. In making nominations for elective directors and officers, the Nominating Committee shall give consideration to maintaining on the Board of Directors a balance of representation from industrial, governmental, educational, insurance, and professional interests; and from different geographical areas.

Section 2. Installation of officers and directors shall take place at the last Business Session of the Annual Meeting. Upon expiration of the term of office of the President, he shall become a member of the Board of Directors to serve for two years.

Section 3. The Board of Directors shall have the power to fill vacancies among the officers and directors to serve until the next Annual Meeting of the Association or until their successors are installed.

ARTICLE IV—DUTIES OF OFFICERS

Section 1. The President shall preside at all meetings of the Association and of the Board of Directors and shall perform such other duties as may be directed by the Board of Directors. He should keep in contact with developments in the field of industrial hygiene and guide the Association in the formulation of constructive activities.

Section 2. The Treasurer shall be the custodian of all monies of the Association, shall receive all monies due the Association, and shall pay all authorized bills against the Association. He shall submit his accounts for audit at the meeting of the Board of Directors held during the Annual Meeting and shall transmit to his successor in office all funds and property of the Association in his possession. He shall submit an annual report to the Association in such form as may be determined by the Board of Directors. Should the Treasurer not be able to perform the functions of his office, the Secretary shall assume the functions of that office. The Secretary and Treasurer shall be bonded in such an amount as shall be determined by the Board of Directors from year to year and in a company approved by the Board of Directors. Expense of bond shall be borne by the Association.

Section 3. The Secretary shall keep an accurate record of all the transactions of all meetings of the Association and of the Board of Directors; shall carry on the correspondence of the Association; and shall

keep an accurate list of the members and their status.

ARTICLE V—DUTIES OF THE BOARD OF DIRECTORS AND EXECUTIVE COMMITTEE

Section 1. The Board of Directors shall hold regular meetings at least twice a year, one of these meetings to be held during the Annual Meeting of the Association. They shall review the activities of the Association as presented by the President. They shall consider the qualifications of applicants and elect to membership those applicants who meet the necessary requirements. They shall appoint an editor to edit papers and carry out procedures established by the Editorial Committee.

Section 2. The Executive Committee shall administer the affairs of the Association as delegated by the Board of Directors. Any expenditures to be assessed against the funds of the Association shall be authorized by the Executive Committee prior to their being incurred. The Executive Committee may authorize the President to approve the payment of any regular items of expenditure up to twenty-five dollars. It shall assist the President in carrying out his activities. It shall be responsible to the Board of Directors for its actions.

Section 3. A Local Section council shall be established. Two members shall be elected to this Council by each Local Section of the Association. The President shall call a meeting of this Council during the Annual Meeting and prior to the meeting of the Board of Directors. The Local Section Council shall communicate to the President any desires of the Local Sections. The President shall present the actions of the Local Section Council to the Board of Directors for their consideration.

ARTICLE VI—COMMITTEES

Section 1. The President shall appoint a program committee, consisting of four members. The President-elect shall act as Chairman of the Program Committee and one of the members shall be the Editor or the Chairman of the Editorial Committee. The duty of the Program Committee shall be to provide the program for each meeting of the Association. Satisfactory abstracts of all papers offered for presentation at the Annual Meeting shall be obtained by the Program Committee at least sixty days prior to the date of the meeting.

Section 2. The President shall appoint an ethics committee of three members, one member of which shall be a member of the Board of Directors. Upon recommendation of the Ethics Committee a membership may be terminated by the Board of Directors; provided that a copy of the charge against the member shall be furnished to him in writing at least thirty days before the meeting at which action is taken. A three-fourths vote of all members of the Board of Directors shall be required to terminate membership.

Section 3. All resolutions for submission to the Association shall be referred to the appropriate committee for study and recommendation.

Section 4. The President shall appoint an editorial committee. This Committee shall establish procedures to carry out the editorial policies of the Association and may recommend to the Board of Directors that certain policies be established.

Section 5. The President shall appoint members to serve and to represent the Association on committees formed by other organizations.

Section 6. The President shall appoint a publications committee to devise means and establish procedures for supplying members with copies of published papers, translations, notes from members, and other items which may benefit the members of the Association.

Section 7. The President shall appoint an award committee. This Committee may select a member or group of members of the Association to receive the American Industrial Hygiene Association Award. This Award shall be made in recognition of outstanding service in the field of industrial hygiene and shall be presented not more frequently than once a year.

Section 8. The President shall appoint such other committees as recommended by the Association or the Board of Directors. He shall appoint special committees at his own discretion to facilitate handling the affairs of the Association or its activities.

Section 9. The membership of all committees appointed by the President shall terminate with the close of the Annual Meeting.

ARTICLE VII—LOCAL SECTIONS

Section 1. The officers of each Local Section must be members in good standing of the American Industrial Hygiene Association.

Section 2. The Constitution and By-Laws of each Local Section must be approved by the Board of Directors of the American Industrial Hygiene Association.

ARTICLE VIII—AMENDMENTS

Section 1. Amendments to By-Laws may be proposed at any Annual Meeting by a majority vote of the members present and voting. Proposed amendments shall be circulated to the voting membership with a letter ballot. A majority of letter ballots returned within thirty days shall be required for adoption.

Local Section News

THE MICHIGAN INDUSTRIAL HYGIENE SOCIETY has completed its local section program for the year. This group of meetings promises much of value to those interested in industrial hygiene in the Michigan Section.

6:30 P.M. WEDNESDAY, OCTOBER 29, 1941 DINNER MEETING—L'AIGLON RESTAURANT, DETROIT, MICHIGAN.

"The Toxicity of Wood Dusts. Industrial Health in Woodworking and Allied Industries"—WILLIAM D. MCNALLY, M.D., Professor of Toxicology, University of Illinois, Rush Medical College; Toxicologist for the Coroner, Cook County, Chicago.

8:00 P.M. WEDNESDAY, DECEMBER 3, 1941—HERMAN KIEFER HOSPITAL AUDITORIUM, DETROIT.

"Gas Masks and Respirators."—Motion pictures in color of official testing methods and discussion. H. H. SCHRENK, PH.D., Chief Chemist Health Division, U. S. Bureau of Mines, Pittsburgh.

WEDNESDAY, JANUARY 14, 1942 — LANSING, MICHIGAN.

"Preventive Medicine as related to Industry" — N. W. SCHOLLE, M.D., Assistant Medical Director, Campbell, Wyant & Cannon Foundry Company, Muskegon, Michigan.

"Safety at Work" — C. M. EMERSON, Personnel Manager, Wolverine Brass Works, Grand Rapids, Michigan.

"Syphilis in Industry" — F. J. WEBER, Passed Assistant Surgeon, U. S. Public Health Service, Washington, D. C.

6:30 P. M. WEDNESDAY, FEBRUARY 18, 1942, FISKE BUILDING, DETROIT, MICHIGAN.

"Industrial Dermatitis in Defense Industries" — LOUIS SCHWARTZ, Medical Director, U. S. Public Health Service, Washington, D. C.

FRIDAY, MARCH 27, 1942 — HERMAN KIEFER HOSPITAL AUDITORIUM, DETROIT.

Annual Meeting and All-Day Conference on Industrial Health Conservation.

(Special conference program to be announced)

The foregoing program is tentative. Further information may be obtained from the Society's Secretary.

THE NEW YORK SECTION is to hear DR. L. F. CURTISS, of the National Bureau of Standards, Washington, D. C., discuss "Radium Hazards in Dial Painting." DR. CURTISS is Chairman of the Advisory Committee which recently prepared a handbook covering this subject, published by the National Bureau of Standards. His talk will include a discussion of physical measurements and engineering control.

THE INDUSTRIAL HYGIENE ASSOCIATION OF GREATER ST. LOUIS held its first fall meeting on September 22, 1941. The speakers were THOMAS J. CLIFFORD, Dust Control Engineer, St. Joseph Lead Company, who spoke on "Dust Control in Metal Mines and Mills", and J. W. DAMMERS, Treasurer, G. S. Blakeslee & Company, of Chicago, who presented a talk on "Solvent Degreasing." MR. JOHN BUXELL, formerly Chief Engineer of the St. Louis Industrial Hygiene Service, has recently been appointed by DR. JOSEPH F. BREDECK, Health Com-

missioner, to the position of Sanitary Engineer and Chief of Sanitation of the St. Louis Health Division. MR. BUXELL, however, will still supervise the functions of the St. Louis Industrial Hygiene Service.

THE NEW ENGLAND SECTION is making plans for another of its informative all-day sessions to include papers on recent work conducted in the field of industrial hygiene. Final plans have not yet been completed.

THE CHICAGO SECTION is making plans for a group of six evening dinner meetings to be held during the year. Tentative arrangements have been made for a discussion of "Solvents" by one of the leading authorities connected with a large user of such materials; results of "Recent Investigations of Carbon Disulfide in the Viscose Industry," by DR. MILTON H. KRONENBERG; "Industrial Ventilation," by LESLIE C. STOKES; "Industrial Hygiene Program as Conducted by a Large Industry," by one of the leading industrial hygienists connected with such an industry; a discussion of "Organization of Industrial Hygiene in the National Defense Industries," by an industrial hygienist closely associated with this work; and "Problems and Accomplishments in Industrial Health," by DR. C. O. SAPPINGTON. The first meeting, on October 3, will be addressed by DR. J. A. BRITTON, International Harvester.

A meeting of the officers and executive committee of the Chicago Section convened on September 26 and prepared a constitution and by-laws for presentation to the members of the section.

THE PITTSBURGH SECTION is making plans to hold a meeting on the evening of November 13, 1941, in connection with the Industrial Hygiene Foundation of America. Information will be released shortly concerning the program.

American Industrial Hygiene Association
Officers of Local Sections

Chicago

Chairman ..... CLARK D. BRIDGES, Casualty Mutual Insurance Company, Chicago.

Vice-Chairman.. JAMES R. ALLAN, International Harvester Company, Chicago.

Secy.-Treas. .... WARREN A. COOK, Zurich Insurance Company, Chicago.

Executive Com.: J. D. BERMAN, Western Electric Company, Inc.; Chicago.

PAUL BRAND, Pullman-Standard Car Mfg. Company, Chicago.

JOSEPH H. CHIVERS, M.D., Crane Company, Chicago.

A. J. R. CURTIS, Portland Cement Association, Chicago.

HARVEY G. HENSEL, Youngstown Sheet & Tube Company, Chicago.

A. G. KAMMER, M.D., Inland Sheel Company, Chicago.

MILTON H. KRONENBERG, M.D., Illinois State Dept. of Health, Chicago.

LESLIE M. RICE, Liberty Mutual Insurance Company, Chicago.

LESLIE C. STOKES, Illinois State Dept. of Labor, Chicago.

EUGENE L. WALSH, M.D., International Harvester Company, Chicago.

Detroit

President ..... WILLIAM R. BRADLEY, Department of Health, Detroit.

President-Elect . STUART F. MEEK, M.D., Chrysler Corporation, Detroit.

Past President .. WILLIAM T. KREBS, M.D., Hudson Motor Car Company, Detroit.

Secy.-Treas. .... WILLIAM N. WITHERIDGE, Department of Health, Detroit.

Executive Com: MARY ALTON, R.N., Michigan Department of Health, Lansing, Michigan.

A. L. BROOKS, M.D. General Motors Corporation, Detroit, Michigan.

H. G. DYKTOR, Michigan Department of Health, Lansing, Michigan.

D. P. IRISH, PH.D., Dow Chemical Co., Midland, Michigan.

T. F. MOONEY, Ford Motor Co., Dearborn, Michigan.

A. O. THALACKER, Detroit Rex Products Company, Detroit, Michigan.

New England

Secretary ..... PHILIP DRINKER

New York

Chairman ..... F. A. PATTY, Fidelity & Casualty Company of New York.

Vice-Chairman.. DR. LEONARD J. GOLDWATER, New York University, College of Medicine.

Secy.-Treas. .... WM. J. BURKE, New York State Division of Industrial Hygiene.

Pittsburgh

Chairman ..... DR. H. F. SMYTH, JR., Mellon Institute, Pittsburgh.

Vice-Chairman.. F. S. MALLETTE, Industrial Hygiene Foundation, Pittsburgh.

Secy.-Treas. .... E. C. BARNES, Westinghouse Electric & Manufacturing Co., Pittsburgh.

Counselers ..... T. LYLE HAZLETT, M.D., Westinghouse Electric & Mfg. Co., and W. P. YANT, Mine Safety Appliances Company, Pittsburgh.

St. Louis

Chairman ..... H. A. THIEMANN, Hartford Accident and Indemnity Company, St. Louis.

Vice-Chairman.. JOHN BUXELL, St. Louis Health Division, St. Louis.

Secy.-Treas. .... MISS AGNES RABBITT, Anheuser-Busch, Inc., St. Louis.

—Continued from page 452

sorbed and a number of the exposed women have since died.

The principal effects of radium are destruction of the blood and the formation of bone cancers.

Tellurium is said to resemble selenium in its action on the human body, but definite information is very scanty. Vanadium is sometimes considered to have an irritating effect on the throat and chest but again details are very difficult to obtain.

The following metals are generally considered to be non-poisonous in so far as industrial use is concerned: Tin, aluminum, gold, silver, copper, cobalt, iron, barium, and titanium.

References:

THE bibliography of industrial medicine is already large and is growing rapidly. It is impossible to list all references, but the following are of special value to students interested in the subject:

Occupation Hazards and Diagnostic Signs. *Bulletin No. 582. U.S. Bureau of Labor Statistics.* Superintendent of Documents, Washington, D.C.

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Mellor's Modern Inorganic Chemistry. PARKES, G. D., and MELLOR, J. W. Longman, Green and Company, 1939.

Manual of Industrial Chemistry (2 vols.) ROGERS, A. D. Van Nostrand Company, 1931.

Chronic Manganese Poisoning in an Ore-Crushing Mill: *Bulletin No. 247. U.S. Public Health Service,* Superintendent of Documents, Washington, D. C.

Industrial Cadmium Poisoning. BULMER, F. M. R.; ROTHWELL, H. E.; and FRANKISH, E. R. *Canadian Journal of Public Health,* Vol. 29, No. 1, pp. 19-26, January 1938.

A study of Chronic Mercurialism in the Hatters' Fur-cutting Industry. *Bulletin No. 234. U. S. Public Health Service,* Superintendent of Documents, Washington, D. C.

Occupation and Health. International Labor Office. Geneva, 1930.

A full list of Government publications pertaining to occupational diseases and industrial hygiene may be obtained by writing to the Superintendent of Public Documents, Washington, D.C.

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